INDIAN CENTRAL JUTE COMMITTEE

Annual Report
of the
Jute Agricultural Research Institute
For the year 1960-61

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1962.

COMMONWEALTH MYCOLOGICAL INSTITUTE
7 JAN 1962

ANNUAL REPORT OF JUTE AGRICULTURAL RESEARCH INSTITUTE FOR THE YEAR 1960-61.

INTRODUCTION

The Farm area consisted of 101.44 acres in one block and another block of 3.24 acres on the northern side of the main Barrackpore-Barasat road, obtained from The Irrigation Dept. of Government of West Bengal. Negotiations for the acquisition of 50 acres of additional land, for expanding the research activities of the Institute, are being continued with the Government of West Bengal.

The total area under cultivation during Kharif season was 45.84 acres, which included 26.57 acres under experimental jute, 3.42 acres under jute for seed, 3.03 acres under Roselle and Mesta, 2.27 acres under paddy, 3.00 acres under Dhaincha for green manuring, 1.90 acres under cow pea, 1.90 acres under fodder crops, 0.75 acres under pulses and 3.00 acres under Allied fibres, such as Ramie, Agave and Sisal. The Gama field occupied 6 acres.

During the winter-season, the total area under cultivation was 25.79 acres, of which 0.50 acre was under Kalikalai (*Phaseolus mungo*) for seed, 2.69 acres under Kalikalai for green manuring, 6.00 acres under lentil (*Lens esculentus*), 0.35 acre under cow pea (*Vigna catjang*) for green manuring, 2.20 rcres under gram (*Cicer aeritinum*), 4.40 acres under mustard (*Brassica* sp.), 5.50 acres under pea (*Pisum sativum*) for seed, 3.25 acres under pea for green manuring and 0.9 acre under linseed (*Linum usitatissimum*) and sunhemp (*Crotalaria juncea*).

Dearth of labourers was keenly felt, specially during the period when actual field operations were in progress, resulting in much inconvenience and dislocation. Sowing in general was delayed due to the late rains, but the season on the whole was favourable, as the rainfall was sufficient during the growth of the crop, but the initial drought affected the crop to a great extent.

The total rainfall has been 54.92" with 106 rainy days. In the month of March, there were 6 rainy days with 3.16 inches rainfall. In April there was rainfall only on one day, the amount being 0.06 inch. In May there was 1.61 inches rainfall distributed over 9 days. In June there was 2.0 inches rainfall distributed over 13 days. The distribution of rainfall for 1960 has been given as follows :—

January	...	...	...	0.00
February	...	...	...	0.00
March	...	...	...	3.16
April	...	...	...	0.06
May	...	...	...	1.61
June	...	...	...	2.00
July	...	...	...	22.94
August	...	...	...	10.21
September	...	...	...	11.41
October	...	...	...	3.30
Noverber	...	...	...	0.23
December	...	...	...	0.00

There has been failure of crop in wide areas due to the drought but those which survived gave a good yield, as the season became favourable from July to October. Seed production was normal excepting where peak period of flowering fell between 20th to 30th September, when storm and rain affected seed setting.

Results of practical utility obtained during the period under review, on Jute and Allied Fibres

The *capsularis* varieties— EC-4142, JRC-206 and JRC-212 (improved recommended variety) proved significantly superior to D154 (old recommended variety) at 1% level yielding 18, 18 and 12 per cent higher respectively. The new improved *capsularis* strains JRC-9527, JRC-6382 and JRC-8429 proved significantly superior to D154 at 5% level yielding

10, 9 and 8 per cent higher respectively, and giving fibre of good quality EC-4142 and JRC-206 are identical in their morphological characters but a month late in maturity than JRC-212 and D154.

The *olitorius* varrieties—JRO-514, JRO-753, JRO-632 (recommended variety) and JRO-452 proved significantly superior to Chinsura Green (the old improved variety) at 1 per cent level, yielding 32, 30, 28 and 28 per cent higher respectively.

In the X_4 generation of X-ray irradiated materials of *capsularis* and *olitorius* varieties, such variants showing economic characters of practical value—*e.g.* non-branching stem, superior plant height, early maturity, disease resistance, and non-shattering pods, have been further developed by suitable techniques of breeding and purification.

Haploid jute plants have been isolated. These will be utilized as far as possible in evolving homozygous diploids by colchicine treatment, to be suitably used in crossing programme.

Anatomical investigations have shown drought resistance characters of leaves and stems in X-ray irradiated materials of JRC-212 and JRC-919, which are being utilized for evolving drought resistance varieties. In JRO-632, materials non-shattering pod with formation of stone walls have been found, which is being utilized.

Foliar spray of nutrients has proved to be an alternative method of fertilizer application. Urea was more effective as foliar spray than Ammonium sulphate.

Preliminary investigations have shown the importance of synthetic hormones in increasing appreciably the yield of fibre when sprayed on the shoots in very dilute concentration of 500 ppm. to 1000 ppm. This may prove to be of economic importance.

Row cropping gives a higher yield of 10-16% and at the same time, cuts down the cost of cultivation by 20% when compared to broadcast

crop. Intercultural operations limited to (2 hand weedings and thinning coupled with 4 wheel hoeings) give a further increase in yield by 8—13%. Further increase of cultural operations to 4 hand weedings and thinnings and 6 wheel hoeings were of no economic advantage.

Manurial trials have shown that variety JRC-212 is a heavy feeder, giving positive response up to 60 lb. N, as compared to JRC-321 and D154. Hence JRC-212 is a better variety under higher level of fertility and do not show up in lower levels.

It has been found that *H. sabdariffa* (R.T. 2) is positively responsive up to 80 lbs. N/acre (Ammonium sulphate) giving a higher yieldof 44.96% over the control. With compost at the same rate, the yield increased to 67.09%.

It has been confirmed as a result of three years trial, that for obtaining better quality of fibre and to shorten the retting period "Shoti" (*Curcuma zeodonia*) leaves, "Kans" (*Saccharum spontaneum*), "Screw pine" (*Pandanus ordaritissimus*), and Coconut leaves have been found to be useful covering materials in retting tanks.

The retting water is rich in plant nutrients and when allowed to enter paddy field, the yield of paddy increased.

Plants which had more than 60 lb. N/acre, were found to be more susceptible to stem-rot and root-rot caused by *Macrophomina phaseoli.*

A type 1172 was found to be superior to D154 with regard to resistance to stem rot and as good as D154 in yield. This may be released for multiplication.

Fungicides against leaf infection by *Macrophomina phaseoli* are effective only upto the 4th week. Green manuring with Dhaincha every fifth year with cowpea in winter has proved to check the spread of disease in the jute fields more effectively than the fungicides.

Two important parasites of *Nupserha bicolor postbrunnea* viz. *Neocatolaccus nupserha* and *Norbanus acuminatus* have been described.

As the larval phase of the pest is a borer, external application of common insecticides is of little value. Biological control in such cases is of importance, and as such, may be useful in planning Biological control.

D.D.T. (50% WP) when in soil does not adversely effect *capsularis* or *olitorius* jute, nor has any residual effect on the crop.

Roselle is much more resistant to nematode infection (*Meloidogyne incognita*) in comparison to jute (*olitorius* and *capsularis*); when 100% infection was found in jute only 6-26% was found in Roselle types.

A. SECTION OF GENETICS & PLANT BREEDING

A. (a) UNIT—PLANT BREEDING :

Short summary of work done last year in unit Plant Breeding—

Jute.—Sixty promising selections were carried forward for further tests out of 145 samples of seeds grown, including 80 capsularis and 65 olitorius varieties. Five Nursery Tests were conducted with four capsularis and one olitorius varieties. On the basis of superior performance of the progenies with regard to plant height, basal diameter and uniformity in flowering and pigmentation, 249 promising lines, 237 capsularis and 12 olitorius were retained for further tests. Six replicated microplot tests, five with capsularis and one with olitorius varieties were carried out. On the results of analysis of the yield data, 30 promising capsularis varieties were retained for further tests. The olitorius materials were discarded due to lower yield than the standard recommended variety—JRO-632. One capsularis varietal trial was conducted with eight varieties. JRC-212 proved significantly superiod to the control D154 at 1% level, yielding 12 per cent higher. Out of a total of 112 simple varietal trials (subvention trials) in cultivators' plots allotted to West Bengal, Bihar, Assam, Orissa. Uttar Pradesh and Tripura, 106 trials were sown and only 43 trials were reported to have been successful.

Allied Fibres.—Two exotic samples of Hibiscus cannabinus received from Russia were maintained. 5 progeny row trials consisting of 2 cannabinus and 3 sabdariffa varieties were conducted. The fibre yield in

5 hybrid selections were greater than the control RT-2. in the varietal trial with Mesta, H. C.-584 and H. C.-583, the new improved varieties of J.A.R.I., gave about 35% and 24% higher yield respectively than the control M. T.-15. Similarly, in the varietal trial with Roselle R.T.-2, an improved variety of J.A.R.I., proved its superiority over the control R.T.-1 (Green).

22 F_2; 7 F_3; 21 F_5; F_6 and 29 F_7 families crosses obtained in H. radiatus and in H. cannabinus and 2 F_2 families obtained from reciprocal crosses were grown and promising selections fairly resistant to diseases, had been made and carried forward. 20 fresh crosses between the bristle and non-bristle strains of H. sabdariffa and 19 back crosses were obtained. 5 fresh crosses and 19 back crosses of early and late strains of H. cannabinus were grown and carried forward.

Breeding

Collection of varieties and types.—44 samples of jute seeds— 42 *capsularis* and 2 *olitorius*, were grown in type plots along with the standard varieties (JRC-212 and D154 in *C. capsularis* and JRO-632 and C. G. in *C. olitorius*) as *controls*. The *capsularis* samples consisted of 39 hybrid in F_7 (between indigenous and exotic varieties), in addition to one exotic and one indigenous type and E.C.-4142 evolved at Pusa. Of the two *olitorius* samples, one was exotic and the other indigenous. In all, 120 selections—110 *capsularis* and 10 *olitorius*, were made on the basis of plant height, basal diameter, maturity, etc., out of which 60 selections—53 *capsularis* and 7 *olitorius*, were retained for further tests.

Nursery Tests

Two Nursery Tests, consisting of one *capsularis* and one *olitorius* were conducted with two replications each. There were 22 treatments in *capsularis* Nursery Test—14 selections from local types, 6 selections of hybrid origin (F_7) and the two improved varieties, JRC-212 and D-154 being used as controls. Five promising and uniform lines from the *capsularis* Nursery Test were retained for further testing.

There were 42 treatments in the *olitorius* Nursery Test—37 selections from local types, 3 from exotic types and the 2 improved varieties, JRO-632 and C.G., being used as controls. In all 13 lines, out of which 10 were apparently uniform and promising and 3 lines though segregating yet promising, were carried forward for further tests.

Microplot Tests

Five *capsularis* replicated microplot trials in lattice design with four replications each, were conducted to test the yield performance of certain lines or varieties carried forward from the previous year's Nursery Tests and 'A' trials (microplot trials). Four trials each had 25 varieties, including 4 improved varieties as controls and one trial had 36 varieties including 6 improved varieties used as controls. The materials included selections from (a) Local types and (b) X-ray treated materials (JRC-212, X-ray treated) and also from (c) hybrid materials. None of the varieties under test proved superior to the standard recommended variety JRC-212 in yield. It was decided to repeat the trials next season.

Varietal trials

(a) One *capsularis* varietal trial was conducted with 10 varieties *viz.* E.C.-4142 (evolved at Pusa, Bihar), JRC-206, JRC-9527, JRC-6382, JRC-8429, JRC-147, JRC-6291, JRC-211, D154 (control) and JRC-212 (control).

The results of analysis of the yield data along with the dates of 1st flowering of the different varieties and their quality index in gm./tex. and weight c.v. per cent are given in Table I.

E.C.-4142, JRC-206 and JRC-212 proved significantly superior to D-154 (control) at 1% level yielding about 18, 18 and 12 per cent higher respectively. The new improved strains viz. JRC-9527, JRC-6382 and JRC-8429 proved significantly superior to D-154 at 5% level yielding about 10, 9 and 8 per cent higher respectively. It may be stated here that E.C.-4142 and JRC-206 are identical in their morphological characters

TABLE I

Capsularis varietal trial.

Layout—Randomized blocks in six replications.
Gross plot—25′ × 16′.
Effective plot—23′ × 14′
Date of sowing—15.6.60.
Harvested on—5.10.60, 6.10.60 and 1.11.60.

Variety	Mean yield per acre (mds.)	Percent on control D154=100	Date of first flowering	Quality Index (gm./tex.)	Weight C. V. %
EC-4142 ...	28.33	118.3	10-10-60	12.7	25
JRC-206 ...	28.28	118.1	9-10-60	13.2	23
JRC-212 ...	26.80	111.9	12- 9-60	12.9	25
JRC-9527 ...	26.24	109.6	12- 9-60	13.1	21
JRC-6382 ...	26.01	108.6	12- 9-60	13.0	21
JRC-8429 ...	25.82	107.9	12- 9-60	13.2	21
JRC-147 ...	25.73	107.5	12- 9-60	13.2	20
JRC-6291 ...	24.19	101.0	12- 9-60	13.3	19
D-154 ...	23.94	100.0	11- 9-60	13.0	21
JRC-211 ...	23.90	99.8	10- 9-60	13.3	21
C.D. (1%) ...	2.39				
C.D. (5%) ...	1.79				
S.E. % ...	2.4				

and in yield performances, but are both about a month late than JRC-212 and D-154 in maturity.

(b) The *olitorius* varietal trial conducted during the current year and the results of analysis of the yield data along with the dates of 1st flowering of the different varieties and their quality index in gm./tex. and weight c v. per cent are given in Table II.

TABLE II

Olitorius varietal trial.

Layout—Randomized blocks in six replications.
Gross plot—20′ × 15′.
Effective plot—18′ × 13′.
Date of sowing—16.6.60.
Harvested between—21.9.60 and 10.10.60.

Variety	Mean yield per acre (mds.)	Percent on control C. G.=100	Date of first flowering	Quality Index (gm./tex.)	Weight C. V. %
JRO-514 ...	24.85	131.7	3-9-60	12.1	20
JRO-753 ...	24.56	130.2	3-9-60	11.3	20
JRO-632 ...	24.23	128.4	8-9-60	12.5	22
JRO-452 ...	24.13	127.9	7-9-60	12.6	24
JRO-620 ...	20.07	106.4	22-8-60	13.0	21
C.G. ...	18.87	100.0	22-8-60	12.4	23
C.D. (1%) ...	1.86				
C.D. (5%) ...	1.38				
S.E. % ...	3.2				

JRO-514, JRO-753, JRO-632 and JRO-452 proved significantly superior to C.G. (control) at 1% level yielding 32, 30, 28 and 28 per cent higher respectively.

Simple Varietal Trials (Subvention Trials) in cultivators' plots

(a) *Number of trial successfully conducted during 1960-61.*— 35 *capsularis* simple varietal trials were successfully conducted, 11 in West Bengal, 6 in Assam, 3 in Bihar, 7 in Orissa and 8 in Uttar Pradesh.

6 *olitorius* simple varietal trials also were successfully conducted 2 in Bihar, and 4 in Uttar Pradesh.

Hybridization

1. Intervarietal

The following *olitorius* intervarietal hybrids were grown in separate nurseries along with their parents as controls, for selection of desirable plants :—

(1) JRO-632 × OT-1507 (Russian Green) in F_4.

(2) JRO-632 × OT-1506 (Russian Red) in F_4.

(3) Sudan Green × JRO-632 in F_3.

(4) Sudan Green × JRO-620 in F_3.

1,015, 1,011, 1,000 and 1,008 best plants were selected from the above mentioned hybrid materials respectively, on the basis of plant height, basal diameter, freedom from disease, maturity, branching habit, etc. Seeds from five good pods per selected plant were collected for further test during the next season.

2. Interspecific

The viable seeds obtained from the cross JRO-632 × JRC-206 of last year (where cross pollination was followed by treatment of the style and the ovary with 38% sucrose with vitamin B_1) were sown. The plants, though appearing like the female parent, bore pods with projections like those of the *capsularis* male parent. Besides, the plants showed strong development of periderm characteristic of *capsularis* and some of them were very vigorous. Selfed seeds of individual plants were collected for further studies during next season.

Polyploids

A few colchicine induced polyploid lines of both *C. capsularis* and *C. olitorius* were grown. Two plants were selected from each culture for maintenance of the polyploid lines.

Genetic Strains

94 strains, 75 of *C. capsularis* and 19 of *C. olitorius* were grown as single plant progenies. After careful checking with respect to pigmentation, branching habit, maturity, height, etc. seeds of 6 plants per progeny, were separately collected for maintenance of the stock of germplasm.

In addition, five wild species of *Corchorus viz. C. aestuans, C. fascicularis, C. tridens, C. trilocularis* and *C. siliquosus* were also grown and single plant seeds were collected, for maintenance of the species.

Lodging in C. olitorius and factors involved

Lodging is a problem in the cultivated varieties of *C. olitorius.* The lodged plants sometimes break and thereby the growth of the affected plants is checked which ultimately depresses the fibre yield. Moreover, entangling of lodged plants causes difficulties in harvesting of the crop.

Preliminary studies indicated that soft or weak wood is one of the factors responsible for lodging in *C. olitorius,* the other important factor being weak root system.

A (b) UNIT—ALLIED FIBRES

Progeny row trials.— Five progeny row trials, two of *H. cannabinus* and 3 of *H. sabdariffa* were conducted during this year. The *H. cannabinus* included one first and one 3rd year trial and *H. sabdariffa* trials included one 1st, one 2nd and one 3rd year trials. In all, 2144 secondary selections, 800 in *H. cannabinus* and 1344 in *H. sabdariffa,* were made. Records on pigmentation, plant height, basal diameter, leaf character, date of flowering, incidence of pests and diseases and other characters were maintained for each of the selections. The results have been summarised as follows :—

(a) *H. cannabinus.*—1st year trial : 19 cultures were tested in this trial along with the control and 320 selections were made. The analysis showed that the standard J.A.R.I. variety gave the highest yield of fibre and was significantly superior to the other

cultures. Seeds of the selections were sent to Amadalavalasa Mesta Research Station, for further test.

3rd year trial : Five families with 5 progenies each were brought forward from the 2nd year trial. In all, 80 selections were made in this trial. The statistical analysis of fibre yield data showed that all the five families gave the higher yields of fibre, 4 families being significantly superior to the control. Seeds of the promising families were carried forward for seed multiplication.

(b) *H. sabdariffa.*—1st year trial : 23 selections of *sabdariffa* were tested and 384 selections were made. 5 selections were found to be significantly superior to the control (RT-1 green) as regards the yield of fibre.

2nd year trial : Five families each having 5 progenies each were brought forward from the 1st year trial of last year. In all, 480 selections were made. From the analysis it was observed that the three hybrid families gave higher yield of fibre; but were not significantly superior to the control (RT-1 green. These will be tested again during next year.

3rd year trial : Five families, each with 5 progenies were tested along with the control. In all 480 selections were made. The statistical analysis showed that all the five families (hybrid families) gave higher yield than the control (RT-1 green), 4 families being significantly superior to the control. Bulked seeds were carried forward for multiplication.

Varietal trial in Mesta (*H. cannabinus*)—One varietal trial of mesta was conducted with four improved varieties of J.A.R.I. 583, 584, 269, 867 and one control viz. MT—15 in 5×5 latin square design. The statistical analysis showed that although the variety 583 and 584 gave higher yields, they were not significantly superior to the control.

Varietal trial of Roselle (*H. sabdariffa*).—One varietal trial of roselle was conducted with improved varieties of J.A.R.I. and N.P. Sab.-5, an improved variety of I.A.R.I. in 5 × 5 latin square design. Germination was very poor due to heavy rains after sowing. This will be repeated during the next year.

Inheritance of characters.— Bristle character in *H. sabdariffa* : 20 fresh crosses between the bristle and non-bristle types of *H. sabdariffa* and 20 back crosses of F_1s with the respective parents were obtained. 20 successful crosses of last year were grown and 32 F_1 plants were carried forward for further study. The F_1s were less bristled. 8 F_1s of last year were grown for F_2 study and segregation of phenotypes was studied. Out of 6 fresh crosses between late and early (RT-26 × Intermedius) strains of *H. sabdariffa*, 5 were successful and carried forward for further study.

A (c) Unit—Cytogenetics

Short summary of work done last year in the unit Cytogenetics— *From interspecific crosses of nine different combinations, seeds were obtained from JRC-212 × JRO-632, Bombay wild capsularis × C. trilocularis,* wild *olitorius × C. trilocularis, JRC-212 × 4n C.G. and Maniksari × 4n wild olitorius. The F_1's resembled female parent. Selections were carried forward. Fresh crosses of scions involving interspecific cross of C. aestuans always as female parent, have shown pod development with apparently healthy seeds with JRC-212 and JRO-632. Reciprocal crosses were not successful. Crosses of scions of JRC-212 and JRO-632 gave empty pods. In inter and intravarietal crosses at 2n × 4n level e.g.: 4n D154 × 2n JRC-212, 4n C.G. × 2n JRO-632 and 4n wild olitorius × 2n wild olitorius, one F_1 plant from the first cross and five from the latter crosses resembled male parent and the rest resembled female parents. From 25 selections of colchiploids, on morphological basis only, one pod (from 0.1% colchicine/6 hrs.) produced tetraploids in JRC-212, the rest being all diploids. No polyploids were found in JRC-206, JRC-918, JRC-919 and Sunnhemp (S.T.92). Segregation of diploids and tetraploids were found in the selections of JRO-632 and mesta (M.T. 15). The tetraploids were deep pigmented in mesta. In the X_2 generation of X-ray irradiated materials*

(JRC-212, JRC-919 and JRO-632) selections for seedling variations did not breed true. Selections for pigmentation variations and time of maturity, however, gave rise to true breeding as well as segregating progenies. Selections for morphological variations and desirable characters were carried forward. X_7 and X_8 generation of capsularis and *olitorius* were *maintained. Seeds collected from labelled pods of 145 capsularis (JRC-212) and 123 olitorius (JRO-632) plants after exposure to Co^{60} source at J.A.R.I. for doses ranging from 1,000 r to 10,000 r, and also the seeds irradiated by Co^{60} source at the World Agricultural Fair for doses from 40,000 r to 200,000 r were carried forward to study the effect of gamma ray irradiation and isolation of variants with desirable economic characters.*

X-ray treatments—Leaf, stem and pod variants

Selections from X_2 generation showed segregation in X_3 generation in majority of the leaf and stem characters of the seedlings. Mutations resembling chlorosis did not breed true. In *capsularis* varieties, however, most of the selections for pigmentation variations, non-branching habit and time of maturity had been found to be breeding true for the characters. In some selections from the X_2 generation, segregations for the character of time of maturity in *olitorius* (JRO-632) and pigmentation in *capsularis* (JRC-212) had been found. Full green JRC-212 selections and green-coppery-red JRC-919 selections segregated giving rise to coppery-red types.

The following variants had been recorded:—

(1) New leaf variants with dry wrinkled leaf showing xerophytic character (e.g. thick cuticle and abnormal stoma with one gaurd cell) and lamina with abnormal shape and albino blotches appeared in some treatments of the *capsularis* varieties (JRC-212, JRC-919).

(2) Variants with non branching habit and superior plant height coupled with earliness (more than one month early over the control) at 90,000 r treatment and with very late maturity at 40,000 r treatment in JRC-919.

(3) Stunted plant with thick, hard stem and very large leaf, which escaped semilooper attack in JRO-632 (at 50,000 r.)

(4) Plants with thick cylindrical stem having crumpled ornamental leaf (at 40,000 r) in JRO-632, which were found to be superior in fibre content. Selections from the above variants, when further developed may give combination of desirable economic characters. These are being carried forward for study in the X_4 generation.

A number of important selections of selfed seeds from the following promising types have been made for further studies;

(a) Non-shattering pod in JRO-632 (at 40,000 r to 90,000 r treatments). The pods are comparatively large and resistant to shattering during harvest.

(b) Very large capsule in JRC-919 (at 70,000 r treatments).

(c) Selections of JRO-632 (from 30,000 r to 90,000 r treatments) which were not affected by root and stem-rot disease.

Gamma ray-treatments from Co^{60} source

In the G_1 generation of JRC-212 and JRO-632, raised from seeds collected from potted plants exposed to Co^{60} source (at J.A.R.I. from initiation of flowering) for doses from 1,000 r to 10,000 r, no characteristic phenotypic changes had been observed. Selections however, were made on the basis of increased plant height and base diameter and also for earliness over the control.

For the study of the effect of chronic gama ray irradiation in jute, the strains JRO-632, wild *olitorius* green, JRC-919 and small pod (a X-ray induced variant of *capsularis*) were grown in the gamma field at J.A.R.I. farm in radial sectors, at definite distance from the Co^{60} source. Seeds were collected from labelled pods, cumulative doses ranging from 1,000 r to 10,000 r.

In the G_1 generation raised from seeds of JRC-212 and JRO-632 treated with a single massive exposure of gamma ray from the Co^{60} source (at World Agricultural Fair, New Delhi), for doses ranging from 40,000 r to 200,000 r, characteristic phenotypic changes appeared affecting all parts of the plant, e.g.: fasciation, pigmentation changes and non-branching habit of the stem ; irregular size and shape, deep serration, folding and curling of lamina and chlorosis in leaf; colour and shape changes of petals, male and female sterility, conversion of a portion of androecium into staminodes in the flower and stumpy shape of the pod. Moreover, changes to early maturing type and improved plant height and base diameter were also observed. Selections of morphological variants and those made on the basis of maturity, vigour and non-branching habit were carried forward for further studies.

Colchicine treatments

In the C_2 generation of the selected tetraploids from the previous year (of JRC-212 and JRO-632) average percentage of germination was 38%. Most of the plants were found to be tetraploids on cytological examination and were short with thick hard stem, short internode, large leaf and flowers and with about 56% pollen sterility. A few plants with comparatively narrow leaves were found to be triploids, on cytological examination, with pollen sterility of 81% and poor seed setting.

Fresh treatments of tetraploid seedlings of C.G. (*olitorius*) and D154 (*capsularis*) with 0.25% colchicine for 6 hours (stem tip treated with cotton swab) were made. Leaf-tip smears of 4n C.G. revealed the presence of 28 and 56 chromosomes, whereas in D154 only 28 chromosomes had been observed. Very few apparently healthy seeds had been obtained.

Selected seeds were carried forward for further studies.

Cytological and cytochemical studies of the induced mutants

Cytological observation of the haploid plant of JRO-632, arising out of X-ray irradiation of 70,000 r treatment revealed the presence of 7 chro-

mosomes in the root tip cells. The 7 chromosomes of the pollen mother cell segregated at random. Cytokinesis took place to form isobilatterally arranged degenerated tetrads. In a flower only one to four full pollen grains had been observed. Seven chromosomes were observed in the root tip cells of three healthy seeds obtained from a haploid plant.

A systematic analysis of the free amino-acid pattern (determined by paper chromatography) in the leaves of the leaf-variants (arising out of X-ray and gamma ray-irradiation) had been made and compared with that of the non-irradiated parental strains. Changed pattern with regard to number and concentration of the free amino-acids had been observed in the leaf variants.

Interspecific hybridization

The F_2 progenies of all the interspecific crosses (reported last year) were found to resemble the respective female parents and were therefore, not carried forward.

Seeds obtained from the following crosses of the scions after grafting, were apparently healthy : *C. aestuans* × JRC-212 and *C. aestuans* × JRO-632. All F_1 plants resembled the female parents. Selected seeds were carried forward for further studies.

Intervarietal hybridization

In the intervarietal crosses at tetraploid × diploid level of the *olitorius* (4n C. G. × 2n JRO-632) and *capsularis* (4n D154 × 2n JRC-212) strains, most of the F_2 plants resembling the tetraploid female parents were found to be tetraploids on cytological studies. No segregation was observed in the *capsularis* strains. Only a few plants, characterised by presence of slender stem, deep seratted rounded leaf and total sterility, segregated from the *olitorius* varietal cross. Meiotic studies revealed the presence of one tetravalent and four univalent chromosomes besides the ten bivalent chromosomes in P.M.C. Selected seeds were carried forward for further study in the F_3 generation.

A (d) UNIT—ANATOMY :

Short summary of work done last year in unit Anatomy— *Fibre content was estimated from transverse sections of stem of 18 genetic strains (some at 4n level also), two wild species e.g. : Corchorus tridens and C. aestuans and of mesta (Hibiscus cannabinus) at 2n and 4n level. The effect of concomitant use of fertilizers and seed treatment with a new nitrogen fixing bacterium (Reported by Roy & Mukherjee) on the fibre content and ultimate fibre dimensions of jute (JRO-632) had been studied. The length/breadth ratio of the ultimate fibre cells showed a general increase in case of the inoculated seeds, and more markedly so by the concomitant use of molybdenum. Measurements of leaf shape and size variations in jute (JRC-212, JRO-632) at different ages of the plant revealed that maximum size of the leaves was attained at pre-bud stage. Morphogenesis at the shoot apex and histogenesis of bulbils in Agave had been studied. Differential stainability of the ultimate fibre cells of jute and allied fibres in some reagents and stains had been found to be a suitable index for identification of unknown fibres. Routine identification by microscopical and chemical methods of fibres received from various sources, was done.*

Anatomical studies of the X-ray and gamma ray-induced mutations

Histological studies of the leaf variants e.g.: dry, wrinkled leaf of JRC-212 and ornamental leaves of JRO-632 revealed their apparent xerophytic nature due to the presence of thick cuticle and scanty functional stomata.

The epidermal cells of the dry wrinkled leaf of JRC-212 were comparatively smaller, with straight walls and most of the stomata were abnormally developed with one guard cell and no stomatal aperture. Similar stomata were also found in the ornamental leaf of JRO-632. The structure of the mesophyll tissue was comparable to the normal strains.

The estimation of fibre contents of the stem-variants of JRO-632 (thick cylindrical stem) and JRC-212 (thick hard stem like tetraploids, but with long internode) revealed the presence of comparatively high percentage of bast fibre cells. The length/breadth ratio of the ultimate fibre

cells also increased by 12%. A comparative study of some peculiarities in the anatomy had been recorded.

The non-shattering pods of the pod variant (JRO-632) revealed new anatomical features e.g.: presence of a layer of stone cells in the endocarp, development of fibre bundles capping the dorsal vascular bundles and scanty mucilage cannal in the mesocarp, which is made up of large parenchymatous cells.

The pod of the haploid plant also showed the presence of a lining layer of stone cells in the endocarp which were arranged with their long axis parallel to the radiaal plane of the pod. The mesocarp cells are very large and thin-walled, without mucilage cannals, except at the base of the ovary. Most of the ovarian chambers were found to be empty showing only a slight development of the placenta into a small parenchymatous hump. Partially developed ovules with well developed integument were also found.

Estimation of fibre content from Transverse section of stem

Fibre content was estimated and ultimate fibre dimensions determined in 36 selections of the *capsularis* varietal trial of the Plant Breeding Unit. The fibre content was slightly more than JRC-212, but without any difference in the length/breadth ratio of fibre cells.

Anatomical study of the intervarietal cross of jute

Most of the F_2 plants of the 4n C.G. × 2n JRO-632 cross resembling the tetraploid female parent were found to have large thick leaves due to extended mesophyll tissue, which included closely packed palisade cells of uniform length reaching more than half of the breadth of the lamina. The stomata were larger than the diploid strain with higher frequency.

The sterile leaf-variants were found with comparatively thin lamina, more or less round in shape, with deep serrations, which were broad at the base, ultimately ending into narrow threadlike ends.

The stomata were of variable sizes, smaller than the normal progeny. The palisade cells were loosely arranged unequal in length, only a few cells reaching up to the middle of the breadth of the lamina.

Allied Fibres

Histochemical and Microscopical studies of long bast fibres

The long bast fibres of Ramie (*Boehmeria nivea*), *Asclepias* sp., *Calotropis* sp. and Sunn hemp (*Crotalaria juncea*) were studied microscopically and the differences of the secondary wall structure compared. The longest fibres in ramie were characterised by the presence of transverse folds, which were not found in any other species investigated. The obliquely longitudinal fissures on the wall were longer in ramie and *Calotropis* than in *Asclepias* and Sunn hemp. The lumen was comparatively wide and uniform in *Asclepias* sp. and *Calotropis* sp.

B. SECTION OF PLANT PHYSIOLOGY & AGRONOMY

B (a). PLANT PHYSIOLOGICAL INVESTIGATIONS:

Short summary of work done last year in Unit Physiology —*The investigations on the flowering behaviour was continued, and the materials obtained from selfed early and selfed late flowers from the population were carried forward. Interesting results on the segregation into early and late flowering plants and their flowering behaviour had been obtained. The effect of controlled photoperiods showed the importance of long days (about 12 hrs. light period) prevailing during the months of April, May and June, as essential for prolonging vegetative stage.*

Further sand culture experiments had shown the importance of Boron as essential micronutrient for the growth and development of Jute. The effects of other micronutrients as Zinc, Manganese, Copper and Molybdenum had been found to be modified by the absence or presence of Boron.

The investigations on the foliar application of nutrients had been continued. The results indicated the efficacy of foliar spray as an alter-

native method of nutrient application. Urea was more effective as foliar spray than Ammonium sulphate which in turn was more effective when applied to the soil.

Preliminary investigations on the effects of different synthetic hormones on the growth and development of Jute were taken up. The results indicated significant response to treatment with hormones like Indolyl acetic acid, Indolyl propionic acid, Indolyl butyric acid, and Naphthalene acetic acid in increasing the vegetative growth, thereby increasing fibre yield appreciably. The effect on the cambium growth was measured in terms of increase in internal growth components like phloem—pyramids, fibre bundles and fibre cells, in series of transverse section of stem.

Nature and Range of flowering and seed formation in different varieties of Jute

The seeds obtained from early and late formed selfed capsules in JRC-212, Fanduk, D-154, JRC-321 and JAP RED (*capsularis*) and JRO-632, JRO-620, C. G., JRO-753 and R-26 (*olitorius*) were sown in lines and in progeny thus raised, the flowering behaviour was studied in detail. The results confirmed the previous findings in that, irrespective of the origin of the mother seeds in the early part of the flowering curve (designated as early) or in the later part (designated as late) there was segregation into the different dates of flower opening. By selection, wide variations in the frequency of flowering have been narrowed down and a population had been evolved where majority of the plants have been found to come into flush of flowering within a definite range. The frequency of flush of flowering in the above material was, therefore, completed within four weeks in *olitorius* varieties and within three weeks in *capsularis* varieties.

An Early flowering strain of JRO-632

Arising out of the above investigations on the flowering behaviour, a selection (JRO-475—1955) showed consistently earlier flowering than the other plants. This was carried forward and maintained during the following years, through further selfing of the early formed capsules and in 1959 sowings, the earliness was recorded to be 23 days and in 1960, the

year under report, the earliness was 25 days. This material is under further observation.

Effect of Temperature and Photoperiods :

Effect of natural environments—The experiments were repeated during the period under report to investigate the physlological response under natural sequence of environmental conditions e.g. temperature, rainfall humidity, and day lengths. The results obtained confirmed the previous findings in that a certain period of long days accompanied by higher temperature was essential for a good vegetative growth in the early stage.

The controlled photoperiodic treatments, varying from 8 hrs. to 24 hrs. light period clearly indicated the responsiveness of both *capsularis* and *olitorius* varieties towards earliness under the effect of short-day treatments, which were below 12 hrs. light period and towards delayed flowering in long day treatments which were above 12 hrs. light period. The continuous light period of 24 hrs. also had a delayed effect on the flowering time in both the varieties. It may, therefore, be concluded that for vegetative phase a period of long days (above 12 hrs. light period) was essential and the diminishing days (below 12 hrs. light period) were favourable for initiation of the reproductive phase.

Experiments on nutritional requirements

Comparative study on the effect of foliar application and application to the soil of nitrogenous fertilizers on the growth and development of Jute

This study has been in progress for the last two years including the year under report and the results indicated an alternative method of application of fertilizers through the leaves, which was also effective in increasing the yield of fibre. During the year under report further experiments were continued with different treatments on JRO-632 and JRC-212.

In case of *olitorius* (JRO-632) the soil application of Ammon. sulphate at 40 lb. N gave an yield of 28.43 Mds/acre and that with urea at 40 lb. N gave an yield of 26.12 Mds/acre, which are significant at 1% level. When 40 lb. N as the source of nitrogen was split up into basal plus foliar spray,

the yield was more in case of urea than in case of Ammonium sulphate in both *capsularis* (JRC-212) and *olitorius* (JRO-632). The comparative yield was found to be more in case of JRO-632, which may be due to the bigger leaf size and larger leaf area for foliar absorption of the nutrients. This was further corroborated by treatments with only foliar application of 20 lb. N, which gave higher yield in case of urea in JRO-632 than in JRC-212 as compared to Ammonium sulphate.

The results tended to show better performance with Ammonium sulphate when applied to the soil than urea; but on the other hand urea tended to give better performance when made available in the form of foliar spray. Further experiments are in progress.

Effect of micronutrients on growth and development

The effects on the growth and development in presence or absence of micronutrients like Boron, Copper, Zinc, Manganese and Molybdenum, when given singly in sand culture with basal Hoagland nutritive solution, have been reported last year. During the period under review the experiments were continued on JRO-632 and JRC-212 with combinations of different micronutrients from which single micronutrient was withdrawn in order to study the effect of absence of any single micronutrient in presence of others.

It was found that Jute when grown in the set containing Hoagland solns. plus (Zn, Mn, Mo, Cu) and minus Boron showed dominant deficiency symptoms with significant decrease in growth rate, in green and dry weights and with poor root growth and delayed flowering The injury to apical growth, mottling and curling of leaves, brown patches with swelling and cracking of lenticels on the stem were the prominent deficiency symptoms. In other sets where Boron was present but other micronutrients were withdrawn, the effects were not so prominent, though the growth was suppressed to a certain extent when compared with the set containing the full complements of all the micronutrients plus Hoagland nutritive solution. This indicated that Boron was the most essential micronutrient which can not be compensated by the presence of other elements.

Effect of different growth hormones on growth and development

The experiments were conducted on JRC-212 and JRO-632 in replicated microplots. The plants were sown on 23.6.60 and the following hormone solutions Indolyl acetic acid (IAA), Indolyl propionic acid (IPA). Indolyl butyric acid (IBA) and Napthalene acetic acid (NAA) in concentrations of 1,000 ppm. and 500 ppm. were sprayed on 12.8.60 and 22.8.60.

In comparison to the controls the treated plants showed prominent apical curvatures of the growing shoot, which gradually recovered, leaving traces of curvature and in the region of curvature, the radial growth of the stem was very prominent. The after effects were shown in increased growth rates both in height and basal diameter, leaf surface, green and dry weights. The retted plants gave higher yields of fibre and wood as compared to non-treated plants. Statistical analysis showed significant difference in green weight, fibre weight and dry wood weight. The percentage increase as a result of treatment with different hormones in JRC-212 varied from 7% to 41% per plant in 1,000 ppm. The increase was recorded in IPA (41%), in NAA (37.86%), in IBA 9.693%) and in IAA (7.161%).

It is known that hormone stimulates cambium activity, affecting phloem and xylem. So the internal growth components, such as fibre-wedges, fibre-strands per wedge and the ultimate fibre cells per strand which constitute the fibre complex and determine the yield of fibre, were estimated in series of transverse sections of stems at the region of growth curvatures. The estimations confirmed the significant increase in the above structures as a result of hormone treatment.

It was also found that *capsularis* variety (JRC-212) responded to treatment better than JRO-632. Further investigations will be continued.

B. (b) Agronomical Investigations

Short summary of the work done last year, in Unit Agronomy

Jute

In the variety-cum-manurial trial, the effect due to variety and manure each were significant in capsularis and olitorius jute. The effect of interaction between variety and manure was however not significant in any case. In capsularis, JRC-212 gave the highest yield and with increasing levels of manuring (upto 60 lb. N) the yield increased. In case of olitorius jute, JRO-632 yielded highest and unlike capsularis, the yield increased up to 20 lb. only. The trial has been concluded and the pooled data of last 5 years (1955-59) have been analysed; the results show that in capsularis jute, the effects due to variety, manure and variety × manure each were significant. JRC-212 yielded highest, followed by "Local", D-154 and JRC-321, when the first three varieties came in the same critical group at 1% level. With increasing levels of manuring the yield increased upto 40 lb. N for all the varieties; in case of JRC-212 application of 60 lb. N gave further increase, which was significantly superior to 40 lb. N. JRC-212 was thus found to respond better at higher levels (60 lb. N) of manuring. In olitorius jute also, the effect due to variety and manure each were significant, but not the variety × manure interaction. Here the highest yield was obtained from JRO-632 followed by JRO-620, C.G. and "Local", the last two varieties being in the same critical group and significantly inferior to JRO-620, which again was significantly inferior to JRO-632.

In the experiment on time of application of Nitrogen, one application at sowing or 2 split applications $\frac{1}{2}$ at sowing and remaining $\frac{1}{2}$ at 6 weeks crop-age gave better results.

The application of new fertilizer mixtures e.g. Nitrophoska-blue, Nitrophoska-green and Complesol, did not show any advantage over ammonium sulphate alone in both capsularis and olitorius jute.

Maximum potential studies with manuring up to 160 lb. N alone or along with PK taken up at J.A.R.I., Nilganj, Sorbhog, Kendrapara. Katihar and Gograghat showed that the response of N was positive up to

a certain limit, which varied from station to station. In capsularis trial at J.A.R.I., the yield increased up to 80 lb. N alone and PK did not further increase it. At Sorbhog, the yield increased up to 60 lb. N, but when PK was added the increase went up to 80 lb. N level in both capsularis and olitorius. In capsularis at Kendrapara and in olitorius at Katihar, the yield increased up to 60 lb. N with or without PK. At Gogaghat (U.P.) the response was not quite pronounced.

Simple manurial trial in the cultivators' fields were also continued. Application of NPK gave substantial increase in all the jute growing districts of Bihar. In West Bengal, Assam, Orissa and U.P., the response due to fertilizers was positive.

Studies on interculture, date of sowing-cum-stage of harvest, triple cropping with jute—paddy—pulses were also continued.

Allied Fibres

Manurial trial with different combinations of NPK on Roselle (H. sabdariffa) showed that application of potash and phosphate had no appreciable effect on the increase of fibre yield, either singly or in combination with nitrogen. Nitrogen, however showed a singnificant effect.

Jute

Time of application of N on the yield of jute fibre

The trial with *capsularis* jute (JRC-212) was concluded this year. The treatments included application of 40 lb. N from five different sources *e.g.* ammonium sulphate, ammonium chloride, urea, ammonium sulphate nitrate and Chileen Nitrate, applied in one, two or three instalments, either at sowing or at 3 weeks or at 6 weeks crop-age and in various combinations. During the current year, like previous season, time of application was significant. No significant differences were observed either from the source of N or the interaction between sources

and time of application. Highest yield of 23.47 md/acre was obtained from 3 split applications ($\frac{1}{3}$rd. at sowing, $\frac{1}{3}$rd. at 3 weeks and $\frac{1}{3}$rd. at 6 weeks crop-age), which was significantly superior to one application made either at 3 weeks or at 6 weeks crop-age. The pooled analysis for the entire period *i.e.* 1956 to 1960 is being made.

At Gograghat, another trial was conducted with ammonium sulphate (40 lb N/acre) applied in one, two or three instalments at various stages of crop growth. The crop was adversely affected due to stem-rot and root-rot.

Effect of NPK on the yield of jute fibre

Trials were conducted with 3 doses of nitrogen (0, 40 and 80 lb.), phosphate (0, 20 and 40 lb.) and potash (0 ,20 and 40 lb.) singly and in all possible combinations at Kendrapara and Katihar with JRC-212 and JRO-632 and Sorbhog and Gograghat with JRC-212. The trial at Sorbhog was badly affected by pests and diseases and no conclusive results were obtained. Data for other trials are being compiled.

Effect of new fertilizer mixtures on the yield of jute fibre

Two trials, one with JRC-212 and the other with JRO-632, were continued with Nitrophoska-blue (NPK), Nitrophoska-green (NPK), Complesol (NP), Complesol with K, as against Ammonium Sulphate alone or with P or PK and a control (no fertilizer). Fertilizers were applied @ 30 lb. N/acre. P and K from superphosphate and muriate of potash respectively were applied in the same ratio as in fertilizer mixtures.

In *capsularis*, highest yield was obtained by the application of 'Complesol' (41.76 md.). Addition of K did not further increase the yield. This was followed by ammonium sulphate (40.78 md.) and Nitrophoska-green (39.05 mds.).

In *olitorius,* highest yield of 29.21 md./acre was obtained by the application of ammonium sulphate alone, followed by Nitrophoska-blue (28.88 md.) and ammonium sulphate +P K (28.42 md.). It was therefore seen that in *capsularis,* the application of fertilizer mixtures did not give any appreciable advantage over ammonium sulphate alone. But in *olitorius,* ammonium sulphate alone gave the best results.

Variety-cum-mnnure-cum-sowing practices on yield of fibre

A composite experiment to study the effects of variety, manure and sowing practices with *capsularis* jute, was continued with the varieties "local", D-154 and JRC-212 ; levels of manuring tried being M_0, M_1 ($N_{40}P_2$ K_{20}) and M_2 ($N_{80}P_{40}$ K_{40}) and the sowing practices followed being broadcast and line-sowings. The results showed that the effects due to variety and manure individually and the interaction between manure and sowing practices only were significant.

Among the varieties, JRC-212 gave the highest average yield and was significantly superior to D-154 and the 'local', both being in the same critical group. The manurial levels were also significant. Highest yield was obtained from M_2 (34.02 mds.) followed by M_1 (31.35 mds.) and M_0 (26.65 mds.)

Maximum potential studies on manuring on yield of jute fibre

The effects of increasing levels of nitrogen with or without PK, were studied in two trials at Sorbhog and Katihar, with JRC-212 and JRO-632 and at Kendrapara and Gograghat with JRC-212. At Kendrapara, the yield of jute fibre increased with increasing levels of nitrogen up to 80 lb. N per acre. Presence of PK gave slightly higher yield than N alone. At Sorbhog timely intercultural operations could not be carried out due to continuous rain, moreover the crop was badly damaged by pests and and diseases and no reliable data could be collected.

Simple manurial trials in cultivators' fields

To ascertain and demonstrate the manurial behaviour of jute under varying soil and climate conditions and to make the cultivators fertilizer

minded, simple manurial trials were continued in the cultivators' plots in different jute growing States, *viz.* West Bengal, Bihar, Assam, Orissa and U.P. The trials were conducted in the non-acid zone of all the above States and in acid zone of Bihar and West Bengal. Out of 204 trials, 44 were allotted in acid zone and 160 in non-acid zone. In the non-acid zone of West Bengal (24 Parganas) NPK yielded highest, giving an extra yield of 4.35 mds., closely followed by NK giving 3.01 md. over control (21.05 md./acre) in *olitorius* jute. In *capsularis,* highest yield was obtained also from NPK giving 4.86 md. of extra fibre closely followed by NK giving 4.00 md. extra over control (18.70 md./acre). Out of 10 trials, in the acid zone of West Bengal, only 4 trials were successful. Application 3 md. lime +20 lb. N gave the highest yield (4.41 md. extra) closely followed by 6 md. lime +20 lb. N (4.22 md. extra) over control (14.25 md./acre). In Orissa, out of 25 trials, confined to the districts of Cuttack, Puri and Balasore, 16 were successful. NPK gave the highest yield in all the districts in both *capsularis* and *olitorius* jute.

Out of 30 trails in Assam, only 15 (5 *olitorius* and 10 *capsularis*) were successful Application of NPK here also gave the highest yield in both the species. The average extra yield in Kamrup district was 10 md. in *capsularis* (control 15.50 mds./acre) and 4.5 md in *olitorius* (control 12.53 mds./acre). In Nowgong district, the extra yield averaged 5 md./acre in *capsularis* jute (control 12.04 mds. acre).

In U.P, 10 trials with *capsularis* and 11 with *olitorius* were successful out of 25 trials allotted for the State. There also, NPK gave the best performance in both the species. Extra yield per acre obtained from NPK was 6.01 md. in *capsularis* (control 19.31 mds/acre) and 4.20 in *olitorius* (control 11.23 mds./acre).

The complete data of the trials conducted in Bihar, have not yet been received. However, the results received so far showed that in the non-acid zone, as in the previous year, NPK yielded highest, giving an extra yield of about 7 md./acre, closely followed by NP approximately 6 md./acre over 11.12 md./acre from control. In acid zone 20 lb

N + 6 md lime gave an extra yield of 6.33 md./acre over control (11.52 md).

Effects of interculture

To find out the optimum number of hand weedings, thinning and wheel hoeings necessary in line-crop, a trial was taken up with JRO-632. One hand weeding plus 4 wheel hoeings yielded about 23 md. of fibre. Yield increased slightly when wheel hoeings were increased to 6. With two hand weedings and 4 wheel-hoeings, the yield was highest (26.11 md./acre). Four hand-weedings on the other hand, appeared to be superfluous and uneconomic and also tended to slightly depress the yield.

Effect of scrapping and wheel hoeing

Effect of interculture by wheel hoe fitted with either scrapper or tines in both line and broadcast sown crops were studied. Treatments included interculture by scrappers or tines either in one direction or crosswise, with or without thinning, as against the normal intercultural practices in line plots. Results showed that wheel hoeing and scrapping in one direction in broadcast plots, which ultimately left the plants in a line, gave slightly higher yield by about one maund over the normal interculture in *capsularis* jute. In *olitorius* however, highest yield (25.62 mds./acre) was obtained from the treatment where wheel hoeing, scrapping and hand thinning were done in a line sown jute. Jute originally sown broadcast and intercultured by wheel hoe and scrapper in one direction to leave the plants in rows and finally thinned out to requisite spacing also yielded more or less the same, when compared to the control sown in lines (24.33 mds./acre).

Effect of date of sowing on yield of fibre

The trial was taken up at Sorbhog with both *capsularis* (JRC-212 and JRC-321) and *olitorius* (JRO-632 and C.G.) jute and at Kendrapara and Gorgraghat with capsularis jute only (JRC-212 and JRC-321 in the

former place and JRC-212 in the latter) with a view to find out the optimum date of sowing in the localities. At Sorbhog and Kendrapara, there were 6 sowing dates, starting from 1st March with an interval of 20 days, while at Gogaghat, from 15th February with an interval of 15 days. At Sorbhog the highest yield was obtained from the 1st March sowing, both in *capsularis* and *olitorius*. At Kendrapara, the sowing by by end of March gave better results when compared to earlier or later sowings. The trial at Gogaghat failed due to drought.

Effect of seed-rate on seed-yield

The trial was taken up at Katihar with *capsularis* and *olitorius* jute by broadcast, to find out the optimum seed rate for seed yield. In *capsularis* trial, 10 seed rates were tried, starting from 1 to 9 lb. per acre to be compared with the control of 5 lb. per acre. In *olitorius* trial, 8 seed rates were taken, e.g. ($\frac{1}{2}$ lb., 1 lb. to 6 lb. and control 3 lb. per acre). In both *capsularis* and *olitorius* the seed yield increased with increasing seed rate up to 6 lb. and 3 lb. respectively. Further increase in seed rate did not give any extra advantage. In *capsularis*, with 6 lb. seed rate, the yield obtained was 6.93 md. acre, followed by 6.29 md./acre with 5 lb. seed rate. In olitorius however, at 2 lbs. seed rate, the seed yield was 6.77 mds./acre.

Triple cropping experiment with Jute-Paddy-Pulses (fith varying dates of sowing of jute

First crop jute was sown in mid-April, end of April and mid-May and harvested at 120, 105 and 90 days crop-age, followed by 2nd crop of paddy. As in last year, out of the two varieties tried, late variety JRC-212 yielded more than the early variety JRC-321. Jute sown by end of April and harvested at 105 days crop-age gave slightly higher mean yield as compared to earlier sowings harvested at 120 days crop-age or to later sowing *i.e.* mid-May and harvested at 90 days crop age.

Paddy as a second crop after jute, transplated on the same date yielded slightly more than the single crop paddy. Like last year, application of heavy doses of manure was found to depress the yield of grain.

but increased the yield of straw markedly in paddy as a single crop or a double crop. Pulse (*Lathyrus sativa*) as a third crop like last year, responded similarly to that of paddy grain.

Triple cropping experiment with Jute-Paddy-Pulses (with varying dates of transplanting Paddy)

First crop jute was sown by the end of April and was harvested at 90, 105 and 120 days crop age. Jute sown on same date and harvested at later stages, gave corresponding higher yield of fibre. Paddy as a second crop after jute gave higher yield of grain than paddy as a single crop when transplanted on the same date. Earlier transplanting by 1st August yielded less grain but more straw than later transplanting *i.e.* 16th and 31st August. Effect of heavy manuring depressed the grain yield but increased the yield of straw. In case of Pulse (*Lathyrus sativa*) the effect of manuring was also similar to that of 2nd crop paddy.

Manurial trial with H. sabdariffa

The trial was conducted on the same model as in last year Ammonium sulphate was used and the treatments were nitrogen at 3 levels as N_0 (No nitrogen), N_1 (40 lbs. of N/acre) and N_2 (80 lbs. of N/acre); P_2O_5 and K_2O each at two levels in the form of super phosphate and muriate of potash respectively *viz.* P_0 (No P_2O_5), P_1 (40 lbs. of P_2O_5/acre); K_0 (No K_2O), K_1 (25 lbs. of K_2O/acre) thus making 12 treatments combination, plus two treatments of compost *i.e.* C_1 & C_2 at the rate of 40 lbs. & 80 lbs. of N/acre respectively and the highest dose of N *ie.* N_3 (120 lbs. of N per acre)—giving 15 treatments in all. The results have been given in the Table III.

From the table above it may be seen that the treatments C_2, $N_2P_0K_0$ & $N_2P_1K_0$ were significantly superior to control at 1% level, yielding about 67%, 45% and 44% higher yield of fibre over the control, respectively. From the results it may also be observed that potash and phosphate had no appreciable effect in increasing the yield of fibre, applied either singly or in combination with nitrogen, but 80 lbs. of N in form of compost or ammonium sulphate gave higher yields of fibre.

TABLE III

Manurial trial with H. sabdariffa.

Layout : Replicated randomized blocks
15 treatments with 4 replications.
Effective plot size : 20′ × 19′ = 1/115 acre (approx.).
Date of sowing : 23.6.61.
Date of harvesting : 29.11.61.

Treatments	Mean yield Mds/acre	Per cent over control	
C_2	13·27	167·09	
N_2 P_0 K_0	12·38	144·96	
N_2 P_1 K_0	12·36	144·72	S. E. — 0·89
C_1	11·66	136·76	5% C. D. — 2·55 mds/acre
N_3	10·82	126·67	1% C. D. — 3·4 mds/acre
N_1 P_1 K_0	10·58	123·44	
N_2 P_0 K_1	10·36	121·31	
N_1 P_1 K_1	10·35	121·19	
N_1 P_0 K_0	10·16	118·96	
N_1 P_0 K_1	9·77	114·96	
N_2 P_1 K_1	9·63	112·76	
N_0 P_0 K_0	8·54	100·00	
N_0 P_0 K	8·03		
N_0 P_1 K_0	7·83		
N_0 P_1 K_1	7·59		

C. SECTION OF AGRICULTURAL CHEMISTRY & MICROBIOLOGY

Short summary of work done last year —*Investigations on the changes in the soil by application of* P_2O_5 *(as superphosphate) at the rate of 10 lb. to 100 lb./acre with different proportions of N (as* $(NH_2)_2$ SO_4*) varying*

from one to three times of P_2O_5 and with jute for 4 years, have produced the following important changes.

(*i*) *The increase of organic matter is more with the application of nitrogen, but with phosphates alone, there had been in many cases a depression in comparison with no manure plots.*

(*ii*) *The exchangeable calcium decreased generally and more so with the added nitrogen.*

(*iii*) *Total nitrogen has increased generally.*

The nature of organic nitrogen and amino acids in the soil changed due to growing of jute and application of fertilisers The quantity and nature of available nitrogen also changed. The available nitrogen also increased due to the falling of jute leaves or leaves and roots when impregnated into the soil, and nitrogen fixation was more in presence of added phosphates. But it has been observed that the yield of jute decreased when grown alone in the same field year after year.

Continued applications of Boron, Vanadium, Copper, Molybdenum, Cobalt and Manganese have given better fibre yield, and Copper, Boron and Cobalt have influenced the seed production. Effect of different types of water on the nitrifying capacity of the soils of the different Substations some typical jute growing areas and of Ramie Research Station were carried out.

In a study of distribution of Azotobacteriacae, the following were found in different jute growing tracts. Azotobacter chroococcum, A. indicum (Biejerinckia indicum), A. acidum (B. acida Roy) *and certain acid tolerant strains of Azotobacter.*

Seed inoculation with A. chroococcum and B. acida were carried out Improvement in the quality of fibre due to inoculation with these strains of bacteria was revealed when a heavy red soil characterised by the absence of nitrogen fixers was used in pot cultures.

Analysis had shown that concentration of nitrogen and potassium were proportionately less in the stem than in the leaves, and calcium is more in the stem. Nitrogenous fertilisers when added upto 80 lb. of N/acre reduced P_2O_5 content of the jute bark, though nitrogen content increased. Magnesium content of the bark also fell with the increase in the amount of applied nitrogen.

It has been found that K_2O/CaO ratio was related to the incidence of disease. As K_2O plays an important role, effect of liming on water soluble K with soils of different Substations and typical jute growing areas were studied.

Disease in plots treated with minor plant nutrients like B, Zn, Cu, Mn, Va, Mo, Mg and C could not be induced even after application of 80 lb. of nitrogen per acre as ammonium sulphate in the 3rd year.

Analyses of retting water showed that the 'Shyamla' colour was more in the presence of ferrous iron, Calcium, Manganese and soluble salts. It had further been found that P_2O_5 and Ca status of the soil status of the soil besides N, exerted an important influence on the Q.R., as also on the possibility of the 'Shyamla' colour formation.

Waste moulds of Penicillium chrysogenum along with bone meal reduced the retting period. Of the different salts studied under laboratory conditions, magnesium phosphate at concentration of 0.5%, 1% and 2% also lowered the retting period in both the species of jute by 5% to 25%.

O_2 rich substances have been found to lower the retting period in the laboratory. Under field conditions, 'Shoti' leaves at Sorbhog and 'Kans' grass at Gograghat, gave encouraging results. Incorporation of Dhaincha (Sesbania bispinosa) and Sunn hemp (Crotalaria juncea) stems in jute bundles had also been found to lower the retting period. Wetting agents influenced the retting of plants grown for seed purpose.

The optimum conditions for retting in the laboratory by Aspergillus niger, Phoma sp., *Chaetomium subterraneum, Mucor abundans, Macro-*

phomina phaseoli had been found to be pH 4-5 and Temperature of 35°C.

The usefulness of retting water was investigated by irrigating rice field. An increase of 10% in grains and 5% in straw was obtained as a result of irrigation with retting water.

SOIL STUDIES

Soil studies in relation to rotation of crops with jute

The study on the effect of growing jute on the succeeding crop of mustard, onion and potato, both with and without nitrogenous fertilisers as ammonium sulphate at the rate of 40 lb. nitrogen per acre with and without liming, to bring back the soil to original pH was continued in the same test plots. The result on the yield of second crop was similar to that of the previous year.

Further studies on the changes in the soil were continued by addition of ammonium sulphate at the different rates, ranging from 0 to 320 lb. per acre, with and without liming (to bring the soil back to its original pH) and growing jute for 4 years continuously. The following changes have been observed :

(i) Total nitrogen and organic carbon (as determined by Walkley and Black's method) had increased and this increase has a relationship with the amount of nitrogen applied irrespective of liming.

(ii) Exchangeable calcium had fallen (0.5 N acetic acid soluble).

(iii) pH had fallen in unlimed plots markedly and in limed plots also there was a fall to lesser extent.

(iv) Exchangeable K_2O had increased markedly.

The experiment to study the differential exhaustion of the soil due to growing of different varieties of jute was continued for the sixth year with the same six varieties of jute *viz.*—JRC-212, D154, Fanduk (*capsu-*

laris) and JRO-632, JRO-620, and C.G. (*olitorius*), in the same plots as in the previous years. It has been found that the different varieties have not influenced the soil nutrient status.

It had been observed that when jute was grown year after year, the yield of jute fell down gradually. It had been found that loss of added available nitrogen from ammonium sulphate was more in the soil cropped with jute where pH was less. The rate of nitrification was also found to be less in soils where pH had fallen. Application of phosphatic fertilisers like superphosphate and also of compost prevented to a certain extent this loss of availability of added nitrogen. In soils receiving both nitrogenous and phosphatic fertilisers, where more available nitrogen was retained in soils when urea was added, than when ammonium sulphate was added as the source of nitrogen.

Seminormal acetic acid soluble calcium was found to decrease by cropping with jute. Consequently the pH of the soil decreased. Application of superphosphate which contained a good quantity of calcium as monocalcium phosphate and calcium sulphate could not counteract this loss of seminormal acetic acid soluble calcium under cultivation of jute. Liming has, therefore, an important role in the manurial schedule of jute cultivation.

With the increase in organic matter in the soil due to cultivation of jute, the copper fixation capacity increased and the availability of manganese was reduced. Acid producing fertilisers like ammonium sulphate, superphosphate etc. tended to increase the availability of manganese.

Microbiological studies

The changes in the soil microflora population with varying soil moisture content between 5% to 25% were studied. Fungal population decreased and bacterial population increased with the increase in the moisture percentage. Changes in the *Azotobacter* population was very little, below 10% moisture. The correlation with *Azotobacter* population and nitrogen fixation was found to be significant at 5% level only with the addition of energy material.

The effect of uptake of nutrients on the chemical nature of the leaves

During the period under report, investigations were carried out on the effect of manuring on the free amino acid content of the crown leaves of the jute plant. It was found that methionine, d-alanine, glutamic acid and aspartic acid were predominating at pre-bud stage. Manuring with compost, different oil cakes, inorganic nitrogenous manures, superphosphate and muriate of potash affect the quantity and number of amino acids present. It may be considered that presence or absence of aspartic acid, glutamine, serine, leucine and r-amino butyric acid may exert considerable influence on the susceptility of the plants to fungal attack and on the quality of fibre.

Role of soil conditions regarding susceptibility to diseases (in collaboration with Mycology)

Chromatographic study of the disease plants

It had been reported that the amino acid get up of the top leaves plants grown under different conditions were different. Amino acid get up of some diseased and non-diseased plants of two different varieties JRC-918 (a resistant strain) and JRC-412 (a susceptible strain) were carried out. The results though not conclusive, showed that the amount of serine is less in no-diseased plants.

Ca : K ratio of the soil influencing plant growth

It was reported previously that the diseased plants contain proportionate less potassium than healthy ones. It had also been observed last year in pot culture that the best yield of jute was obtained when Ca : K (applied to the soil) was 2 : 1, both with and without nitrogen as ammonium sulphate. The work was carried out in glazed pots this year also and the previous results were confirmed.

Role of micronutrients in disease resistance

The test plots where different doses of B, Zn, Cu, Mn, V, Co, Mo & Mg were added did not suffer very much from diseases, though nitrogen

at the rate of 80 lb. per acre from ammonium sulphate was made available to the plants. It has, however, been found that continued application of borax (2.5 lb-7.5 lb./acre), sodium vanadate (1 lb./acre), copper sulphate (5 lb-7.5 lb./acre), ammonium molybdate (2 lb.-3 lb./acre), zinc sulphate (2.5 lb/acre), cobalt nitrate (0.5 lb.-1.0 lb./acre), manganese sulphate (2.5 lb.-5 lb./acre) gave better results in some cases up to 30% over control so far fibre yield was concerned. In addition, it was found that borax (5.0 lb./acre), copper sulphate (5 lb./acre) and ammonium molybdate (3 lb./acre) increased the yield of seeds in some cases up to 20% over control.

Influence of soil conditioners on the soil texture

These experiments were continued to find out the best treatment for the improvement of

(1) Sandy soil of Sorbhog by the addition carbonaceous organic matter (jute sticks), green matter *Dhaincha—Sesbania bispinosa*), water hyacinth leaves with or without sodium silicate, phosphate fertilisers, lime.

(ii) Heavy red soil of Kendrapara Substation, with jute sticks, straw, *dhaincha* (*S. bispinosa*) with and without phosphates and lime and different phosphatic fertilisers, bone meal, superphosphate and sodium phosphate. It may tentatively be stated that jute sticks with lime and sodium phosphates had given better results.

(iii) Near Usar soil of Gograghat Substation, by incorporation of tops and branches of jute plants, waste molasses, sunn hemp as green manure. The application of tops and branches of jute had given equally good results as application of molasses.

Retting and quality of fibre

Colouration of fibre

The analyses of retting water carried out during the season showed that the soluble salts, total nitrogen and pH of the water also played a

part in the development of Shyamla colour, besides ferrous iron, calcium and manganese.

Further experiments were carried out at Sorbhog, Gograghat and Kendrapara Substations. The results obtained in the previous year were confirmed *i.e.* at Sorbhog, if shoti leaves were used as covering matter, the fibre was the best so far colour, lustre and uniformity of retting were concerned. Screw pine leaves gave best results, so far colour and lustre were concerned in Kendrapara Sub-station.

It has been found that hydrogen peroxide and aeration to maintain 2-3 p.p.m. of dissolved oxygen in the water have shortened the retting period in the laboratory. In pilot scale experiments at Katihar, addition of hydrogen peroxide and aeration, and at Jajang, application of hydrogen peroxide have produced better coloured fibre and the retting period has also been less than the control.

Retting of Jute

It was confirmed that incorporation of Dhaincha (*Sesbania bispinosa*) in jute bundles lowered the retting period by 4 days (14 days against 18 days in control) at Kendrapara and the screw-pine leaves reduced the retting period to 17 days against 23 days of control. Water hyacinth and cocoanut leaves were also found helpful in reducing the retting period. The results obtained at Sorbhog and Gograghat were similar to the results of previous years, *i.e.* application of *shoti* leaves was the best at Sorbhog and *Kans* grass at Gograghat.

Biochemical changes during retting

Work with allied fibres was carried out during the year under report.

For the investigation about the hemicellulose decomposition during retting of *Hibiscus cannabinus* and *H. sabdariffa* and *Boehmeria nivea,* a strain of *Aspergillus niger* and a sp. of monoverticiliate *Penicillium* were used for the retting.

Pentoses and hexoses which were not present in the ribbons in free state were found in the retting system of *H. cannabinus* and *H. sabdariffa*

during retting with *A. niger* and *Penicillium* sp.. Moreover these sugars are identical with the sugars obtained by the hydrolysis of hemicelluloses isolated from *H. cannabinus* and *H. sabdariffa*. This indicates that hemicelluloses present in the plant are decomposed into component sugars by fungi during retting.

Isolation and maintenance of cultures responsible for retting

The following cultures have been obtained from American Type culture collection—

(i) *Sporocytophaga myxococcoides.*

(ii) *Cytophaga aurantiaca.*

(*iii*) *Cytophaga fermantans.*

A mixed culture obtained from rotting plants from Gograghat had given encouraging results under laboratory conditions. Among others, a new nitrogen fixing organism has been found from these, which is being identified.

Use of retting water as fertiliser for paddy

As the work on the test plots suffered in the previous years due to vagaries of weather, work in pots were also carried out. It has been found in pots, retting water gave higher yield of paddy than application of muriate of potash (40 lb. K), or superphosphate (40 lb. P_2O_5) alone, but more or less the same as 20 lb. nitrogen as ammonium sulphate in the first year, but with K_2O and P_2O_5 the yield was higher. Retting water alone gave about 25% higher yield of grains, with K_2O and P_2O_5 about 50% higher over control (no manure) and 5 per cent over 20 lb. N, 40 lb. K and 40 lb. P_2O_5 NPK treatment.

D. SECTION OF MYCOLOGY AND PLANT PATHOLOGY

Short summary of the work done last year.— *Blakeslea trispora attacked foliage during dry spell. The 'blackspot' or 'false anthracnose' of olitorius crop was found to be associated with Phomopsis* sp. *and a Collectotrichum*

sp. (*earlier reported as Vermicularia* sp.) *The different strains of Rhizoctonia solani from jute roots were described. It was shown that older jute plants could resist stem-rot infection better than younger plants i.e. early sowing was better. High temperature of soil was correlated with seedling blight and flood irrigation reduced the incidence. The pycnidia-forming and non-pycnidia-forming strains of R. bataticola were described. Pathogenicity of R. solani was positive on olitorius seedlings. Seed-coat colour or other external characters of seed could not be correlated with presence or absence of Colletotrichum corchori, which caused anthracnose in capsularis. Culture No. 1172 proved more resistant to stem-rot than standard strains; Nos. 1640 and 1627 also were considered good in this respect.* F_5 *selections from JRC-412 × D154 were brought forward. 5 different fungicide were tried against stem-rot in a field trial. A short summary of the incidence of diseases in different States was made. Pathogenicity of Phytophthora parasitica on roselle was established. There was no difference in the incidence of foot and stem rot of roselle in different treatments with fertilizers including N, P and K. Application of K beyond 4 years @ 50 lb. K/acre with or without lime was found unnecessary in Tarakeswar area.*

Study of the microflora of jute fields

4 fungi including 3 unidentified members of 'mycelia sterilia' and *Aspergillus niger* were isolated from the plots of the farm. These fungi had repeatedly been obtained from the disintegrating debris of jute stubbles in the summer following harvest.

Study of the effect of foliar application of K in JRC-412 with respect to incidence of stem-rot

JRC-412, a susceptible variety was sown on different dates *viz* : 21st March (A), 5th April (B), 6th May (C), 20th May (D), 4th June (E) and 19th June (F). Potassium nitrate (300 ppm.) was sprayed on the foliage on 8.7.60, 10.7.60, 12.7.60, 14.7.60 and 23.7.60 on the assumption that the intake of K by leaves may help to prevent the incidence of stem rot; as it was earlier established that a low K_2O/CaO ratio in jute plants

indicated susceptibility. Records of stem rot infection was kept periodically after spray.

The results did not indicate clearly the role of potassium nitrate in resisting leaf infection by *Macrophomina phaseoli* leading to stem rot.

Effect of Nitrogen as top dressing & foliar spray on the incidence of stem rot of jute. (In collaboration with Section of Physiology)

The trial conducted at Kendrapara included four treatments consisting of a basal dressing of 30 lb.P/acre and 40 lb.K/acre. Ammonium sulphate and urea at 20 lb. N/acre were sources of Nitrogen applied as top dressing and foliar spray in split doses. Incidence of stem-rot was recorded in both the crops of JRC-212 and JRO-632. The preliminary observations showed more plants to have been affected by stem rot in Ammonium sulphate sprayed plots than in urea sprayed plots.

Preliminary investigations on the antagonism of soil micro-organisms against Macrophomina phaseoli

Isolation of organisms both bacteria and fungi from the jute rhizosphere in sick and normal healthy soil was started; a bacterium from the latter was isolated which showed strong antagonism to *Rhizoctonia bataticola* (isolated from infected jute plants) in plate culture on potato-dextrose agar. The bacterium is being maintained and further isolation is being continued to obtain a full picture of the rhizosphere flora from sick and healthy soils.

Study of the pathogen other than Macrophomina phaseoli

Colletotrichum sp.

The *Vermicularia* sp. reported earlier, as causing anthracnose of *olitorius* jute was recognised to be a species of *Colletotrichum*, as the genus *Vermicularia* has now been abandoned; (*vide* Duke in Trans. Brit Mycol. Soc. 13, pp. 156-184).

The symptoms on *olitorius* were as follows :—Spots brown to start with, small- 1 mm, orbicular, later elliptical 2 mm. to 3 mm., deep snuff

brown to black. Spores scanty on host but, profuse in fresh isolation ; 7.6 μ × 5.2 μ to 17.2 μ × 5.5 μ ; 1 celled cylindrical with rounded ends; a few spores ellipsoid; mostly cylindrical uniform in size and shape— 14.3 μ × 4.8 μ ; spores en masse brick red, the transmitted light under microscope hyaline; fresh spores show granular contents, in desiccated spores the cytoplasm often contracts forming a median pseudo-septum. setae rare on host, but plenty in fresh isolations. Brown with 2 to 3 septa; lumen narrow; 318 to 439 μ long and 15 to 20 μ at the broadest point which lies slightly above the base. Formation of setae does not take place after repeated subcultures.

Lesion caused by this fungus often reaches the tip of the fibre wedges. Incidence was high when application of Nitrogen exceeded 60 lb. N/arce.

Phomopsis sp : Causes superficial black spots of irregular shape, often coalescing together, usually confused with those caused by the *Colletotrichum* sp. The two are often associated in the same stem, sometimes in the same spot. 'A'-type spores, hyaline, 1-celled, round ellipsoid to fusiform 5.2 to 7.9 μ long and 1.7 μ to 1.9 μ broad; these are formed in pycnidia which form a black subicle in artificial culture. 'B'-type spores, hyaline single celled, bent like a fishing hook, 18.2 μ to 24.1 μ long and 1.0 μ to 1.4 μ broad, usually uniformly broad throughout except for the tip where it is slightly acute.

Inoculation studies with the Colletotrichum sp.

The spores produced in artificial culture were used for inoculation studies. Spore masses from two weeks old cultures of a fresh isolate were taken in sterile water and sprayed on plants of JRO-632 of different ages, grown in pots treated with 80 lb. N/acre.

The results indicated that infection was more successful when low temperature prevailed. The experiments could not be controlled properly, as the pots had to be kept in the open (in absence of a glass house). The results, however, indicated that the fungus mostly attacked mature plants receiving a liberal dose of nitrogen (usually above 60 lb. N/acre). It did

not attack plants when average day temperature was around 32°C or higher.

On re-isolation in 4 cases, out of 21, *Phomopsis* sp. was found associated, which may be taken as secondary aerial infection. In the absence of a green house, more controlled conditions were not available for inoculation studies.

Isolation & purification of the two bacteria associated with wilt of jute (in collaboration with Chemistry Section).

Jute grown in jute-potato fields of Hooghly district showed symptoms indicative of bacterial infection. Presence of bacteria in abundance in vessels was recorded. Isolation of the two bacteria designated A and B have been purified. The characters as noted are :

A. Rods, gram-negative, motile produces a clear, thick, opalescent colony on potato-glucose agar. Colony turns creamy in old culture.

Medium containing protein turn bluish green.

Steamed potato turns brown to black. Produces acid from sucrose and maltose. Does not liquefy gelatin.

Attacks potato stolon causing rot and wilt. Attacks young potato tuber causing rot and dissolution of starch.

B. Very small rods, often in chain. Gram negative and motile. Forms a whitish creamy smooth colony on potato glucose agar. Starch is not hydrolysed. Growth on sterile potato-yellowish.

The bacteria singly and in combination did not attack 45 days old *olitorius* plants when the inoculum was presented on potato tubers.

Study of the development of anthracnose disease in the field

100 selected plants of different types of *capsularis* were observed periodically. It has been found that types differed with regard to susceptibility. Infection started from middle of July and the period of

maximum infection, in terms of number and extent of damage, was third week of August.

A few selections have been made from among those which escaped infection.

Investigation on control of diseases

SELECTION FOR RESISTANCE TO STEM ROT.

Yield trials with selected types.—The types selected for resistance to stem-rot were put on yield test the results given in Table IV.

Of the branching types No. 1172 is a good desirable type ; 1640, 1637 and 1652 also gave good yield. Amongst the non- branching types there were types superior to JRC-5854 in resistance, but inferior with regard to yield.

Incidence of stem-rot and anthracnose in different *capsularis* varieties

Diseases, particularly stem-rot and authracnose, were recorded in the *capsularis* varietal trial conducted at Nilganj. The mean stem-rot percent based on sample counts in six blocks involving nearly 1,800 plants for each variety are recorded in Table V. The figures for anthracnose including both cankerous and non-cankerous types are given in the same table. It may be noted that mortality due to anthracnose was low though damage to fibre was great.

Similar record of disease in the Microplot test series of *capsularis* types, were collected from each plot. Record indicated that type C-Hy-57-7954, C 57-8241 and 53-8429 were more resistant to standard types with regard to stem-rot and anthracnose under field conditions. C 55-206 is a good strain in this respect.

Study of selections from the cross D154 × JRC-412

The F_6 were grown at Gogaghat and Assam, in the latter place the trial was not successful and therefore only seeds were carried forward.

TABLE IV

The behaviour of selected types with regard to disease and yield

Branching types	Percent stem-rot on control (D154)			Mean yield md./acre		
	1958	1959	1960	1958	1959	1960
1637	57·47	51·61	68·47	23·78	15·92	13·60
1652	70·18	43·93	59·92	23·58	18·45	15·31
1640	80·68	133·26	98·39	28·85	19·78	14·06
1627	83·97	49·20	43·62	23·21	19·96	13·32
1653	82·74	53·25	40·46	22·64	18·21	13·76
1626	85·02	57·60	32·97	21·69	18·69	12·32
1607	116·39	105·19	130·73	22·14	14·74	12·48
1608	134·60	143·49	101·74	23·52	14·44	11·18
D154	100·00	100·00	100·00	22·14	21·17	15·55
				P Large	Large	Large
1172	79·72	46·34	38·15	21·64	19·06	18·06
1140	81·74	45·26	79·91	20·88	14·31	15·81
1212	94·95	52·03	51·91	18·11	14·13	16·02
1161	60·55	32·79	65·82	20·98	13·44	16·18
1137	113·67	47·97	40·66	19·03	15·52	15·04
1217	116·00	35·23	38·53	19·16	13·44	16·27
JRC-212	139·54	35·77	44·40	25·62	17·00	18·60
D154	100·00	100·00	100·00	21·31	18·06	17·06
				S.E. % 4·5	8·8	
				C.D. 1% 2·53	5% 3·9	1% 2·44
Non-branching types						
1235	70·43	87·73	59·60	14·42	8·37	13·10
1222	81·55	95·91	60·15	17·07	12·47	13·10
1229	90·66	130·45	75·64	11·68	11 05	11·05
1234	79·92	65·91	52·00	17·37	11·02	12·84
1228	89·38	109·55	63·08	14·12	9·82	12·30
1223	74·09	87·73	48·99	15·09	12·35	13·50
JRC-5854	93·52	304·55	89·88	19·02	15·34	14·80
D154	100·00	100·00	100·00	19·48	13·74	14·08
				C.D. 1% 3·88	3·96	2·3

TABLE V

Record of stem-rot and anthracnose infection in capsularis varieties.

Treatment	Mean P. C. stem-rot.	Mean P. C. anthracnose.
Cx-58-8429	9·11	6·41
C-Hy-52-6291	11·6	6·31
C-Hy-52-6382	9·6	5·16
EC-4142	14·0	6·36
C-Hy-53-147	13·1	2·91
D154	8·2	15·16
C-57-211	15·1	14·6
C-Hy-52-9527	7·3	18·36
JRC-212	12·7	13·36
JRC-206	9·6	4·13

At Gograghat further selections were made from the survivors of drought. 15 types were brought forward for microplot yield test and for test of resistance under field conditions.

At Nilganj, types were checked for uniformity of flowering time and pigmentation.

Effect of different fertilizers on the incidence of stem-rot

Incidence of stem-rot was recorded in JRC-212 receiving different treatments of N, P and K without any basal dressing at Jajang, Cuttack. Nitrogen as ammonium sulphate beyond 80 lb. N/acre incited incidence of stem-rot. Addition of both P and K could not check the incidence of disease in plots receiving Nitrogen at 80 lb. N/acre or beyond. The higher dose of N even when coupled with P and K was found harmful in respect to stem-rot.

TABLE VI

Incidence of stem-rot in JRC-212 under different treatments of N, P and K at Jajang (Cuttack).

Treatment.	No. of plants observed.	Percent stem-rot.
N_0	3948	1·4
N_{20}	6220	2·5
N_{40}	4339	5·6
N_{60}	4202	6·7
N_{80}	3872	11·7
N_{160}	3403	13·5
N_0 P_{10} K_{10}	3939	1·2
N_{20} P_{10} K_{10}	4212	1·8
N_{40} P_{20} K_{20}	4256	3·1
N_{60} P_{30} K_{40}	3896	4·3
N_{80} P_{40} K_{40}	3896	31·1
N_{160} P_{80} K_{80}	2926	47·7

Relative efficacy of different fungicides in checking stem-rot

Copper oxychloride 0.25%, 0.5% and 0.75% with and without sticker (Tenac : Burmah Shell) was used in a field trial with JRC-412 as susceptible variety. Spraying was begun after final thinning and six sprays were given between 15th June and 8th August, having a rainfall of 28.4″ inches with 38 rainy days. Copper oxychloride at 0.75% proved more effective, the volume remaining same for all treatments. Effective protection was observed up to third week of July. Thereafter, the sprays at all strengths proved ineffective, probably due to rain. The sticker did not improve the situation.

TABLE VII

Showing stem-rot percent in different treatments with copper oxychloride ; var. JRC-412 ; age of crop : 32 days.

Treatment copper oxychloride		Stem-rot percent on 20-7-60
0·25%	without sticker	2·16
0·25%	with sticker	2·06
0·5%	without sticker	2·65
0·5%	with sticker	3·55
0·75%	without sticker	1·80
0.75%	with sticker	1·90
Control (No Spray)	...	3·49
Sticker only	...	2·12

There is an indication that if the fungicide could be made to stay on the leaves and stems, effective protection could be given.

Records of disease, collected in later days showed that there was difference among the treatments.

In a second field trial, colloidal-copper proved slightly better than "captan" or copper oxide, but such differences were not considered significant. The reduction in incidence was about 5% than the control plots; but it proved uneconomic.

It has been shown elsewhere that soil conditions were more important in controlling incidence of stem-rot. Besides this, use of more resistant varieties such as JRC-212 is more helpful under the present conditions

Study of the effect of different rotation on the incidence of diseases of jute

It has been again confirmed that in alluvial tracts of 24-Parganas where jute and mustard have been grown for 4 years successively without a basal dressing of Farm yard manure, compost etc. incidence of stem-rot was as high as 18 per cent. resulting in death of such plants

It has been found that incidence of stem and root-rot of jute was of no consequence when aman paddy was grown every third year and green manuring with "Dhaincha" was done in fifth year in high-lands where aman paddy is unsuitable ; aus paddy also gave good results, but not to the same extent. Thus in a six-year cycle "Jute-Jute-Paddy-Jute-Green manure-Jute" has given goods results with regard to diseases caused by *Macrophomina phaseoli.*

Breeding and selection for resistance to diseases in *Hibiscus cannabinus*

The F_6 from the interspecific cross between *Hibiscus cannabinus H. radiatus* were grown. Selections were brought forward on the basis of freedom from diseases, excepting phoma-leaf-rot, incidence of which was not considered, as the latter does not affect the yield.

Effect of deep ploughing on the incidence of foot-rot

The deep ploughing was done by Landmaster Tractor (Walking type). Incidence of foot-rot was noted in deep ploughing plots and control plots. Records indicate that deep ploughing has not been helpful in checking foot-rot caused by *Phytophthora parasitica.*

Comparative resistance of *H. cannabinus* **and** *H. sabdariffa* **to foot and stem-rot**

In a replicated randomised field trial, it was found that incidence of foot and stem-rot in *H. cannabinus* was 2.9 while it was 8.85 in roselle, the variety tried being MT 129 and RT 2 respectively.

At seedling stage however, the *cannabinus* seedlings were attacked by pathogen other than *Phytophthora.*

Studies on the pathogen *Phytophthora parasitica*

The variety of *Phytophthora parasitica* isolated from roselle failed to produce oospore in culture under normal conditions. It had however been noticed that oospore can be induced in culture medium within forty five days, by growing the fungus along with a species of *Xanthomonas* at room temperature varying between 22°C—26°C.

Pest and Disease Control Scheme, Tarakeswar

The jute stubbles of some selected sick plots covering an area of about 3 acres of farmers' plots chosen at random were examined. It was found that on an average 3.8% of the stubbles were found to bear sclerotia of *Rhizoctonia bataticola.*

It has been observed that effects of potash and calcium in checking wilt in Tarakeswar area was more pronounced when farm yard manure was applied.

Rotation of crops and green manuring however were the most effective remedy.

E. SECTION OF ENTOMOLOGY

Short summary of work done last year.— *In connection with the study on the effect of soil depth on the diapausing larvae of Nupserha bicolor postbrunnea, it has been found that when exposed to surface, dormant larvae were mostly predated upon. An approximate release from dormancy of about 70% was noted diapausing larvae exposed to a depth of about 4 inches. It has been found that under the field conditions, mortality of the dormant population in soil was mainly due to the activities of predators. Hydration or infection from other soil pathogen was of very minor importance. Another parasitic species under genus Norbanus was recorded on the larvae and pupal phases of Nupserha beetle.*

Preliminary observations were recorded throughout the whole jute season with regard to the zonal distribution of incidence of Apion corchori on the stem of one capsularis variety—JRC-212 and one olitorius variety—JRO-632. Incidences have been found to be distributed to the top, middle and bottom portions. In Apion resistance trial, desirable materials were carried forward.

24 hrs. TL$_\eta$ values for Labeo rohita (fingerling stage) have been found to be 0.0087 ppm. of 20% Endrex E.C.; 0.40 ppm. of Endrex 1% dust; 3.53 ppm. of Dieldrex 1.5% dust, 2.29 ppm. of Folidol E 605

(46.7%) and 2.24 ppm. of DDT (WP-50%). The corresponding values in case of Cirrhina mrigala (fingerling stage) have been found to be 0.007 ppm.; 0.53 ppm., 3.51 ppm., 2.79 ppm. and 4.49 ppm. for Endrex 20% E.C., Endrex 1% dust, 2.29 ppm. of Folidol E 605 (46.7%) and DDT (WP-50%) respectively.

No adverse effect of DDT (WP) when in soil was found on the growth and fibre yield of both capsularis (D154) and olitorius (C.G.) jute, as in the previous years.

It has been observed from a trial carried out in a farmer's field at Baduria (24-Parganas) that roselle (RT-2) was much more resistant to Meloidogyne incognita in comparison to jute (JRO-632).—In 44 and 101 days old jute crop, 55.40% and 100% plants were infested with infestation index of 0.77 and 3.62 respectively, while in 44 days and 101 days old roselle crop percentage of infestation was nil and 31.55%, infestation index being nil and 0.32 respectively. It has been found that Agrilus acutus showed almost a negative preference to capsularis jute in comparison to mesta. Casual incidences of the pest was recorded on JRO-632 and JRO-620.

Pest and Disease Control Station, Tarakeswar

Anomis sabulifera was wide spread. Necessary protection measures were taken for effective control of various pests. Endrex E.C. was popular with the cultivators because of its cheapness and efficiency. It has been found from trial carried out in the cultivators' field that 5 prophylactic sprays at weekly intervals with half the recommended concentration viz: 0.37% (actual) in case of DDT and 0.015% (actual) in case of Endrex, were effective.

ENTOMOLOGICAL INVESTIGATIONS

NUPSERHA BICOLOR POSTBRUNNEA

Reciprocal exposure of diapause larvae to low and high soil moisture treatments

To ascertain the effect of reciprocal treatments of high (16% appr.) and low (below 2%) moisture in soil to the diapausing larvae, one controlled experi-

ment was set up. There were six treatments including control in the experiment with four replications. Ninety six diapausing larvae were used. Reciprocal treatments were gviven after one and two months' interval. Effect of these treatments on the larval phase and on the elimination of diapause phase is being recorded.

Parasites

Two new chalcidoid parasites have been described. These are the most important larval and pupal parasites recorded and account for nearly 20 per cent parasitisation during July-August. The parasites are :—

(a) *Neocatolaccus nupserhae* Dutt & Ferr. (Fam., Pteromalidae, Subfam., Metasteninae). Distinctive characters of the species are given below : ♂ ♀ Head and thorax dark green, almost black. Antennae, tegulae, wing venation brown, propodeum shiny.

♀ Head round in front, punctate, regulose with striations diverging from clypeus. Mandibles 4-dentate. Lateral ocelli closer to the median ocellus. Inter-ocellar space greater than ocular-ocellar space. Antennae inserted slightly above the lower ocular border, three transverse annelli, third little larger than others, funicular joints five. Thorax with white pubesence, pronotum short, paraspidal furrow incomplete, propodeum without a nucha, spiracle large and almost rectangular. Forewings with slight discoidal ciliation at the base, marginal vein somewhat thickened, almost half the length of submarginal, stigmal vein shorter than post marginal and half as long as the marginal. Distal tarsal ends are almost white, tibia with two unequal spurs. Abdomen with greenish coppery shine, oval, pointed behind, ovipositor very slightly protruding.

Male Smaller than female. Antennae with two annelli and six funicular joints. Distal tibial ends and tarsi whitish, hind tibia with two spurs. Abdomen oval, white centrally, in the genitalia, distal phallobasic lobe bears 2-3 denticles.

Length : ♀ 3.6 mm ; ♂ 1.8-3.4 mm.

(b) *Narbanus acuminatus* Dutt & Ferr. (Fam. Pteromalidae, Sub-fam.— Metasteninae). Distinctive character of the female are as follows :—

Head and thorax are almost black with white setae. Antennae black or brownish black, basal third of scape brown, legs brown, coxae, femora blackish, knees and apical third of tibias whitish. Abdomen with greenish copper shine.

Head rounded in front, rugulose, punctate with striations diverging from clypeus. Right mandible 4-dentate, left mandible 3-dentate. Ocelli forming a low triangle. Antennae inserted at the same level or slightly below the lower orbital border, two transverse annelli, second twice as long as the first, funicular joint six, club with three points, the apical one terminates to a spine.

Thorax punctate, arched, paraspidal furrow incomplete, scutellum little shorter than broad, propodeal spiracle large and almost rectangular. Forewing with slight discoidal ciliation, marginal vein almost as long as the submarginal, Stigmal vein almost as long as two fifth of the marginal.

Hind tibia with two unequal spurs.

Abdomen oval, pointed at tip, ovipositor not or very slightly protruding.

Length : 3.5—5 mm.

Male unknown.

Apion corchori

(1) **Zonal distribution of incidence on stem during different periods of the season**

To facilitate insecticidal spray treatments for control of the grub inside the stem particularly during the advanced stage of crop growth when the plants are tall, weekly observations were recorded, for determining the zonal distribution of incidence during different periods, from 100 selected plants of each of JRO-632 (*olitorius*) and JRC-212 (*capsularis*). The crop was sown late (21-6-60) and conditions for sufficient Apion incidence were unfavourable. Under the experimental conditions, high level of incidence, in both these varie-

ties, was recorded during first week of September and second and third weeks of October. During these periods, bottom portion in both the varieties was given a preference for incidence over the middle and the top.

(ii) **Ovarial score during different periods of the year**

Observations on the ovarial score were recorded during the jute season (September & October) and in off jute season (November, December, January, February) from specimens reared in the laboratory and collected from natural source.

It was observed that the ovarial activity did not remain altogether suspended during off jute season, even though the score became low.

(iii) **Selection for Apion resistance**

20 selections from different *capsularis* types were sown in a replicated trial keeping D154 as control. Desirable materials have been brought forward. 19 selections from *olitorius* varieties were sown in a replicated trial keeping C.G. as control. Desirable selections have been carried forward.

(iv) **Parasites**

Few parasites, recorded on the grub stage of the pest, are under observation.

ANOMIS SABULIFERA

(i) **Observations on the immature stages**

Further observations on the different instar caterpillars and the pupa were made and their distinctive features, including chaetotaxi have been made. In connection with the study of variability of pigmentation pattern, large scale laboratory breeding was undertaken. In F_2 generation, early first instar progenies were predated upon by ants for which work suffered.

(ii) **Parasites**

Two endo-parasites of the caterpillar stage have been recorded, which have been identified as follows :—

(a) *Sisyropa formosa* Mensil. (Dipt., Tachinidae).

The parasite usually appears during the latter part of the jute season. One parasite per host is the usual occurrence. Parasited caterpillar is not easily recognised before emergence of the parasite from within the body of the host for pupation outside.

(b) *Litomastix* sp. (Hym., Encyrtidae).

Natural parasitisation percentage by this endoparasite is low at present.

The parasites have been identified through the courtesy of the Commonwealth Institute of Entomology.

Residual effect of the insecticide DDT when in soil on plant growth and fibre yield

Capsularis (D154) and *olitorius* (C.G.) jute were grown as in the previous years in the same layouts, but without application of DDT in soil for assessment of residual effect, if any. In both the trials, germinations were not uniform due to adverse climatic condition which resulted in variations in stand in different treatments. Observations were, however, made on 10 plants selected at random from each treatment. No adverse effect either on *capsularis* or *olitorius* jute was noted. In some previously—DDT—treated plots, higher yield was recorded.

MELOIDOGYNE INCOGNITA

(1) Relative susceptibility of olitorius, capsularis, mesta & roselle

One micro-plot trial with 4 replications was carried out at Jute Agricultural Research Institute farm in a known infested area. JRO-632, C.G. (*olitorius*), JRC-212, D154 (*capsularis*), MT-129, (mesta), RT-1 and RT-2 (roselle) were included in the trial for assessment of relative susceptibility. Monthly observations were made from samples drawn from each treatment. None of the *olitorius*, *capsularis* or *mesta* varieties showed significant difference in incidence percent (100 in all cases) or in infestation index, the range being 3.20 — 4.55. The roselle varieties, RT-1 and RT-2 showed much lower infestation index (0.20-0.25) and incidence percent varied from 6 to 26. Pod forma-

tion was not much affected in the infested plants. Approximately 13 pods per plant in *olitorius*, 42 pods per plant in *capsularis* and 13 pods per plant in mesta have been recorded on average.

(ii) **Jute field weeds as alternative hosts**

Attempts were made to locate alternative host plants of the nematode from among the jute field weeds. *Blumea lacera* (Compositae), *Ageratum conyzoides* (Compositae), *Rungia praviflora* (Acanthaceae) and *Oldenlandia corymbosa* (Rubiaceae) have been recorded, in J.A.R.I. farm, as jute field weeds, which are alternative hosts of the pest. These weeds are prevalent, particularly, during the later part of the season.

Insect pollinators of jute

(a) **Insect pollinators**

Collection of insect fauna during the flowering period was not up to expectation for making any conclusion.

(b) **Apportioning role of insects as pollinators vis-a-vis other agencies**

In connection with this study, *capsularis* varieties JRC-212 and JRC-321 were grown in alternate lines in a plot. Similarly JRO-632 and JRO-620 were raised in alternate lines in another plot. From each of JRC-212 and JRO-632, 30 selections were made, of which half the plants were screened by wire-net cages before flowering and the rest remained open. Necessary records with reference to pods of individual selection have been maintained for further studies.

AGRILUS ACUTUS

(i) **Host preference studies with reference to olitorius, capsularis, mesta and roselle :**

Two *capsularis* varieties (JRC-212, JRC-321), two *olitorius* varieties (JRO-632, JRO-620), one mesta variety (MT-129) and one roselle variety (RT-1) were selected for study of relative host preference in a replicated field trial. The pest showed highest preference to mesta followed by roselle. Incidence of the pest was not recorded on *capsularis* or *olitorius* varieties.

(ii) **Varietal susceptibility of mesta :**

Records on incidence variation on five varieties of mesta namely 269, 583, 584, 867 and MT-15 were taken from a trial conducted by the Allied Fibre Unit, for assessment of relative susceptibility. Sowing was rather late (21-6-60) and as such, conditions were unfavourable for high level incidence. During the second month stage of growth, MT-15 and variety 584 showed no incidence. Low level of incidence was, however, recorded in all the varieties up to the third month stage of growth.

Pest and Disease Control Station, Tarakeswar

Incidences of pests were rather low during the season. Incidences of *Anomis sabulifera* and *Nupserha bicolor postbrunnea* were, however, comparatively high as shown in the table below. Affected areas, received insecticidal treatments and the cultivators co-operated in pest control operations.

TABLE VIII

Per cent acreage under incidence of different pests (based on observation made on 84 acres)

Name of the pest.	Per cent incidence.			
	1-3	4-20	21-40	More than 40
Anomis sabulifera	78·6	15·5	...	...
Diacrisia obliqua	4·8	...	...	...
Laphygma exigua	8·3	...	...	...
Apion corchori	3·6	...	...	...
Nupserha bicolor postbrunnea ...	20·2	...	...	...
Hemitarsonemus latus	7·1	...	...	...

To find out the residual effect of different soil insecticides like Aldrex 5% dust, Dieldrex 5% dust, Haptachlor 3% dust and chlordane 5% dust against *Microtermes obesi*, JRO-632 was raised in two separate layouts, in which the above insecticides were used in the previous year. No incidence of the pest was noted in any of the treatments, including control.

Endrex E.C. has been found to give better performance under the field conditions for the purpose of control of *A. sabulifera* in comparison to DDT (WP) and Folidol E 605.

Emergence and subsequent incidence of *Nupserha bicolor postbrunnea* from the fourth week of June, was preceded by about 10 inches rainfall, confirming earlier observations in this connection.

Observations on the natural parasitisation of the pest were made and it is found that the activities of the parasite started from the second week of July up to harvest in September.

Herbarium and Museum

The specimens of jute, allied fibre plants and the weeds of the cultivated fields, which had been collected earlier, were maintained after cleaning and by application of preservatives. Fibre and seed samples of jute and allied fibre crops were supplied to different Government and Non-Government organizations, when requested.

On behalf of the Indian Central Jute Committee, some temporary museum articles were sent to the National Agricultural Fair, Calcutta, for exhibition. Permanent museum arrangements for J.A.R.I. are still in progress.

Library

The Library consisted of 3,529 valumes, out of which the journals numbered 1135. The foreign journals were 827 and Indian 308. During the period under report 142 books have been added including the I.C.A.R. publications. 110 scientific periodicals have been received of which, 82 are on payment of subscription, 11 on exchange and 17 as complementary. In addition, 68 Government and Non-Government reports, brochures and pamphlets on agriculture and allied subjects have also been added. 115 volumes of periodicals have been bound during the period.

The library is mainly used by the members of the staff of the Institute and also by the scientific workers of other research Institutions.

Training

A training programme, as in previous years, in the improved methods of jute cultivation and promotion of jute production, in two batches of 10 days' duration each, was arranged at the Jute Agricultural Research Institute, Nilganj. In all 29 trainees, 3 from the extension wing of Indian Central Jute Committee from West Bengal and Orissa, 26 Jute Development and Community Development staff from Assam, Bihar, Orissa and Uttar Pradesh, attended the course.

The training covered all important aspects, including practical training of jute cultivation. The course included lectures on improved varieties of jute—their performance in respect of yield and quality and their identification in the field ; improved methods of cultivation including line sowing, top-dressing with fertilisers, double and triple cropping ; improved retting—techniques and removal of " Shyamla " colour of jute ; control of insect pests and diseases and methods of extension work. The handling of seed-drills, wheel-hoes, sprayers, dusters, seed-dresser, etc. was also explained and demonstrated to the trainees.

MISCELLANEOUS

Enquiries

A number of enquiries relating to jute and other allied fibres, were received for comments from the Government of India and also from various other Indian and Foreign sources, including industrial and research institutes. Suitable notes in reply were prepared and communicated.

Visitors

A number of distinguished personalities, including foreign dignitaries, visited the Institute and showed keen interest in the progress and achievements of the Institute. The names of the following may be mentioned :—

(1) Shri V. Shanker, President, Indian Central Jute Committee and Special Secretary, Ministry of Food and Agriculture, New Delhi.

(2) Dr. James L. Brewbaker, Biology Department, Brookhaven National Laboratories, AEC, Upton, New York, U.S.A.

(3) Mr. N. S. Chuvakhin, Russian Entomologist, U.S.S.R.

(4) Mr. A. J. Bekr, Director General, Ministry of Agriculture, Baghdad, Iraq.

(5) Mr. S. A. Gsami, Ministry of Agriculture, Baghdad, Iraq.

(6) Mr. A. V. Selvanov, Chief Engineer of the Scientific Research Institute of Mechanisation of Agriculture, U.S.S.R.

(7) Mr. S. F. Lepushinsky, Chief of the Examination Department of the Tractor Assembly Shop of the Kharkov Tractor Plant, U.S.S.R.

(8) Mr. S. Tsukahara, Koizumi Jute Mills Ltd., Nada Kobe, Japan.

(9) Mr. K. Aramaki, Koizumi Jute Mills Ltd., Nada Kobe, Japan.

(10) Mr. H. Kimura, Chief Representative, Marubenilida Co., Ltd., Calcutta Office.

(11) Shri C. M. John, Vice-President, Indian Central Arecanut Committee, Cherukara Farm, Kerala.

Acknowledgement

I am grateful to Sectional Heads and the other members of the staff of this Institute for the help rendered by them, in the compilation of this report.

K. T. JACOB
Director
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PUBLICATIONS

List of papers published or sent for publication during 1960-61.

1. Dutt, N. (1960). Preliminary observations on the incidence of termite attacking jute. Sym. Term. Humid Trop. Sec. 6.

2. Dutt, N. (1961). Studies on the bionomics of jute stem girdler, *Nupserha bicolor postbrunnea* Dutt (Col. Laminidae). Bull. Ent. Res. 51.4. 765-779.

3. Dutt, N. (1961). A note on the varietal susceptibility of mesta and roselle seeds to Spermophagus tersellatus Mots. Proc. Ind. Se. Cong. III. 429.

4. Dutt, N. and Bhattacharja, S.P. (1960). Toxicity of some insecticides to carp fingerlings. Proc. Zool. Soc. 13, 1, 43-49.

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7. Ghosh, T. & Mukherjee, N. (1961). Comparative incidence of Diseases in Kenaf and Roselle under field condition. Proc. Ind. Sc. Cong.

8. Jacob, K. T. & Sen, Subir. (1961). Haploidy in Jute (*Corchorus olitorius*). in press. Nature.

9. Kar, B. K. (1961). Investigations on the Physiology of Jute Part V—Growth & Development of Root-system in *C. capsularis* and *C. olitorius* in press. Ind. Jour. of Plant Physiology.

10. Kar, B. K. (1961). Investigations on the Physiology of Jute Part III—Variations in the production of Bark and Wood in certain varieties of *C.capsularis* and *C. olitorius*. Proc. Nat. Acady. of Scis. India. Sec. B. Vol. XXXI. Part I. 67-75.

11. Kar, B. K. & De Sarkar, B. K. (1960). Investigations on the Physiology of Jute Part IV—Variations of certain internal growth components influencing the yield of fibre in *C. copsularis and C. olitorius*—in press. (Jour. Ind. Bot. Soc.)

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14. Kundu, A. K. & Mukherjee, M. K. (1961). Influence of pH and temperature on the fungal retting of Jute. Proc. Ind. Sc. Cong. Part III.

15. Mandal, A. K., Roy, A. B. & Mukherjee, M. K. (1961). Effect of manuring on the free Amino acid content of jute leaves of *C. olitorius*. I—Influence of Nitrogen from different sources. Proc. Ind. Sc. Cong. Part III.

16. Mukherjee, N. & Ghosh, T. (1960). Corynespora cassiicola (Burk etc. Curt) Wei. Science & Culture. Vol. 26, 270-271.

17. Mukherjee, M. K. & Pal, H. (1961). Nitrification of ammonium sulphate and Ammonium chloride in Mesta (*H. cannabinus*) growing soils of Andhra Desa. Proc. Ind. Sc. Cong. Part III.

18. Prakash, G. (1960). Jute ke Rog aur unki roktham—Part I., Kheti, February, 1960. (Hindi).

19. Prakash, G. (1960). Jute ke Rog aur unki roktham—Part II, Kheti, March, 1960. (Hindi)

20. Prakash, G. (1960). Jute ke Rog aur unki roktham—Part III, Kheti, April, 1960. (Hindi)

21. Rakshit, S. C. & Kundu, B. C. (1961). New species and varieties of Hibiscus. Sci. & Cult. 27, 192-194.

22. Sen, S. & Paul, S. (1961). —Stomatal types in the genus *Corchorus* Proc. 48th Ind. Sc. Cong.

23. Sen, S., Mondal, A. K. & Roy, A. B. (1961). Histological studies on the relationship of free-amino acids in the leaves of jute. 48th Indian Sc. Cong. Vol. III. Part III.

24 Sen, S., Mondal, A. K. & Roy, A. B. (1961). Free amino—acid content of variant jute leaf (*C. capsularis and C. olitorius*)— in press.

APPENDIX

A-Section of Genetics & Plant Breeding

Programme of work as sanctioned	Progress of work in 1960-61	Future programme of work in 1961-62
Breeding & Genetics of Jute		
Collection of varieties & types.	44 types, 42 *capsularis* and two *olitorius*, were grown and in all 60 promising selections, 53 *capsularis* and 7 *olitorius* were carried forward.	To be continued.
Nursery Tests.	60 selections, 20 *capsularis* and 40 *olitorius* were grown for progeny testing in two separate nurseries. 18 promising lines, 5 *capsularis* and 13 *olitorius* were retained for further tests.	To be continued.
Micro-plot Tests.	5 capsularis replicated micro-plot tests were conducted to test mainly the yield performance of certain varieties carried from the previous year's nursery tests and 'A' trials. None of the varieties under testing proved superior to the recommended variety—JRC-212.	To be continued.
Varietal trials.	In the *capsularis* varietal trial EC-4142, JRC-206 and JRC-212 proved significantly superior to D154 at 1% level yielding 18, 18 and 12 percent higher respectively. Both	To be continued.

	EC-4142 and JRC-206 are about one month later in maturity than JRC-212 and D154. The new improved strains, JRC-9527, JRC-6382 and JRC-8429 proved significantly superior to D154 at 5% level yielding 10, 9 and 8% higher respectively.	
	In the *olitorius* varietal trials, JRO-514, JRO-753, JRO-632 and JRO-452 proved significantly superior to C.G. at 1% level yielding 32, 30, 28 and 28% higher respectively.	To be continued.
Simple varietal trials (subvention trials).	41 simple varietal trials (subvention trials) 35 *capsularis* and six *olitorius* were successfully conducted in cultivators' plots in the different States. The yield data of the trials conducted in West Bengal were analysed. No significant difference in yield was observed among the four improved varieties viz. JRC-212, D154, JRC-5854 and JRC-321. Similar results were also obtained from the trials conducted last year (1959-60) in West Bengal, Bihar and Assam.	To be continued.
Hybridization.	4 olitorius intervarietal hybrids, two in F_1 and two in F_2, were grown. Bulk seeds of about 1,000 best plants per cross were carried forward under the Modified Mass Method for further tests next season. The interspecific cross between *C. olitorius* and *C. capsularis* was followed up.	To be continued.

Programme of work as sanctioned	Progress of work in 1960-61	Future programme of work in 1961-62
Polyploids.	Some colchicine induced polyploids of *C. capsularis* and *C. olitorius* were grown for maintenance.	To be maintained.
Genetic strains.	94 strains, 75 of *C. capsularis* and 19 of *C. olitorius* were grown for maintaining the stock of germplasm.	To be maintained.
Lodging in *C. olitorius*.	Soft or weak wood appeared to be a major factor in lodging of the cultivated varieties of *C. olitorius*.	To be continued.
Unit—Allied Fibres:		
Progeny row trials	5 progeny row trials, two of *Hibiscus cannabinus* and 3 of *H. sabdariffa* were conducted. In *cannabinus*, four families in 3rd year trial were significantly superior to the control MT-15.	Seeds will be multiplied for the yield trial.
	In the first year trial of *sabdariffa*, 5 hybrid selections were found to be significantly superior to control, (RT-1 green), as regards the yield of fibre.	To be continued.
	2nd year trial of *sabdariffa* was not significant.	To be repeated.

	In 3rd year trial of *sabdariffa* 4 families (hybrid materials) were significantly superior to the control, as regards the yield of fibre.	Seeds will be bulked for yield trial.
Varietal trial (*H. cannabinus*).	H.C. 583 new improved variety of J.A.R.I., gave the highest yield of fibre, being about 19% higher than the control, MT-15, but the differences were not significant.	To be repeated.
Natural crossing study in mesta (*H. cannabinus*).	All the plants having entire leaf were selected and seeds of each single plant selection were collected.	All the single plant progenies will be grown to determine the % of natural crossing.
Inheritance of character.		
bristleness character in *H. sabdariffa*.	20 fresh crosses between the bristle & non-bristle strains of *sabdariffa* and 20 back crosses of F_1S with the respective parents were obtained. 20 successful crosses of last year were grown and 32 F_1 plants were carried forward for further study. The F_1's were less bristle. 8 F_1S of last year were grown for F_2 study and segregation of phenotypes were studied.	To be continued.
Earliness in *H. sabdariffa*.	Out of 6 fresh crosses between late and early (RT-26 × Intermedius) strains of *H. sabdariffa*, 5 were successful and carried forward for further study.	Further fresh crosses will be made & to be continued.

Programme of work as sanctioned	Progress of work in 1960-61	Future programme of work in 1961-62
Unit—Cytogenetics		
Irradiation studies using X-rays, in jute		
Isolation and purification of variants for desirable economic characters.	Variants with promising economic characters eg : xerophytic leaf variants in JRC-212 (at 10,000r), non-branching stem variants showing early maturity and superior plant height in JRC-919 (at 90,000r), crumpled ornamental leaf with thick stem and high fibre content in JRO-632 (at 40,000r), pod variants with non-shattering pod in JRO-632 (at 40,000r to 90,000r) large pods in JRC-919 (at 10,000r) and root rot resistant types in JRO-632 (at 30,000r to 90,000r) were isolated and selfed seeds carried forward for further studies in X_4.	Selfing of the variants and crossing with the non-irradiated parental varieties to be done in the X_4 generation. Further studies to be continued.
Cytogenetical studies of the induced mutants	Segregation of characters i.e. time of maturity in JRO-632 and JRC-919 and anthocyanin pigmentation in JRC-212 recorded in X_3. Majority of the seedling variants did not breed true. Haploid plant isolated from JRO-632 at 70,000r treatment had been cytologically and embryologically examined.	Further studies to be continued.

Irradiation studies using gamma rays.	The stem, leaf and pod variants of JRC-212 and JRO-632 at G_1 arising out of chronic irradiation and irradiation of single massive dose from cobalt 60 source were carried forward, together with selections for vigour and earliness, for study of G_2 generation.	To be continued.
	JRO-632, wild *olitorius* green, JRC-919 and small pod *capsularis* (a X ray induced variant) were grown in the gamma field (cobalt 60) source at J.A.R.I. for study of the effect of chronic gamma ray-irradiation.	To be continued.
Study of Colchicine treated series.	C_2 generation of JRC-212 and JRO-632 are cytologically examined and tetraploids isolated had shown 81% pollen sterility. Selections carried forward for further studies.	To be continued.
Study of Interspecific and intervarietal hybrids.	The F_1 seeds of inter-specific crosses of scions of *C. aestuans* × JRC-212 and *C. aestuans* × JRO-632 grafts were carried forward for further studies.	To be continued.
	All the F_2's of 9 different combinations of inter-specific crosses using JRC-212, Bombay wild *capsularis*, maniksari, JRO-632, C. G., wild olitorius (2n × 4n) and C. trilomlesis, resembled female parents.	Selections not carried forward.
	Selections from F_2 plants resembling female parents in 4n × 2n crosses intervarietal crosses e.g.: C.G. × JRO-632 and their partially sterile leaf variants were carried forward.	To be continued.

Programme of work as sanctioned	Progress of work in 1960-61	Future programme of work in 1961-62
Unit—Anatomy		
Study of the effect of X rays and gamma rays on anatomical structure.	Dry wrinkled leaf variants of JRC-212 and ornamental leaf variants of JRO-632 showed the presence of xerophytic characters in the leaf i.e. thick cuticle, scanty functional stomata etc. High fibre content and increased length/ breadth ratio of ultimate bast fibre cells had been found in stem variants with thick cylindrical stem in JRO-632 and thick, hard stem with long internodes in JRC-212. New anatomical features eg : stone cell layer in endocarp, fibre bundle cap of dorsal vascular trace and absence of mucilage canals in mesocarp had been found in pod variants with non shattering pods in JRO-632.	Anatomical studies to be continued.
Study of bast fibre cells of jute.	Fibre content from 36 selections of *capsularis* varietal trial showed slight increase over the standard type JRC-212.	Study to be continued in collaboration with the Genetics and Plant Breeding Unit.
Leaf size variation at different stages of growth.	Studies in the strains JRC-212, JRC-919, JRO-632 and JRO-620 revealed that leaf size increased gradually upto pre-bud stage, then diminished rapidly, so that at large pod stage	To be continued.

	the new leaves were as small as the first to third leaf.	
Structure of wall of bast fibres in the allied fibre plants.	Difference in the structure of secondary wall of *Boehmeria nivea*, *Calotropis gigantia*, *Asclepias* sp. & *Crotalaria juncea* had been determined from microscopical and histochemical observations.	Study completed.
Anatomical studies of the intervarietal hybrids of jute.	Partially sterile leaf variants of at F_2 of 4n C.G. × 2n JRO-632 cross showed difference in anatomical structure of the leaf, in the presence of variable size of stomata and palisade cells which were loosely arranged.	To be continued.
B-Section of Plant Physiology & Agronomy		
Unit—Plant Physiology		
Nature and range of flowering and seed formation in different varieties of jute.	The work was continued in the following varieties—*Capsularis*—JRC-212, Fanduk, D-154, JRC-321, and Jap red. *Olitorius*—JRO-632, JRO-620, C.G., JRO-753 and R-26. The results confirmed the previous findings that, irrespective of the origin of the mother seeds in the early part of the flowering or in the late part there was segregation into different dates of flower opening. By selection, wide variations in the flowering frequence had been narrowed down, and a population has been	Completed.

Programme of work as sanctioned	Progress of work in 1960-61	Future programme of work in 1961-62
	evolved where majority of the plants were found to flower within a definite range.	
	A selection (JRO-475-1955) showed consistently early flowering by about a month.	This material will be carried forward for further observations.
Effect of temperature & photoperiods.	The experiments were repeated, under controlled conditions of photoperiods, as well as under natural sequence of environmental conditions e.g. Temp., rainfall, humidity and day lengths. The critical period of photoinduction and the temperature effect had been worked out.	Completed.
Experiments on nutritional requirements.	The experiment was repeated with ammonium sulphate and urea at the rate of 20 lbs./N 40 lbs./N. as top dressing and compared,	To be continued.
(a) Foliar application of nutrients.	when the same quantity were sprayed on the shoot portion of the plants, in split doses. Urea was more effective as foliar spray than ammonium sulphate. The incidence of diseases were recorded by the Mycology Section.	
(b) Effect of micro-nutrients on growth and development.	The experiments were continued further in combination of different micro-nutrients from which single micro-nutrient was withdrawn in order to see the effect of absence of any single	To be continued.

	micro-nutrient in presence of others. It was found that plants grown in the set containing Hoagland soln. plus (Zn, Mn, Mo, Cu.) and minus Boron gave the dominant deficiency symptoms—of injury to apical growth, mottling and curling of leaves, brown patches with swelling and cracking of lenticels of the stem.	
Effect of synthetic Hormones on Growth and Development.	The experiments were continued in micro-plot replications on JRC-212 & JRO-632 with the following hormones—Indolyl acetic acid (IAA), Indolyl propionic acid (IPA), Indolyl butyric acid (IBA) and Napthalene acetic acid (NAA), sprayed in concentrations of 1000 ppm. and 500 ppm. The treated plants showed prominent apical curvatures of the growing shoot which gradually recovered, leaving traces of curvature. Statistical analysis showed significant difference in green weight, fibre weight and dry wood weight. In JRC-212 the increase in fibre yield was recorded in IPA to be 41%, in NAA—37.86%, in IBA—9.683% and in IAA—7.161% per plant.	To be continued.
Effect of Gibberline on Growth & Development.		This will be taken up, on receipt of Gibberlic acid.

Programme of work as sanctioned	Progress of work in 1960-61	Future programme of work in 1961-62
Unit—Agronomy		
Manurial trials		
1. Time of application of nitrogen on the yield of jute fibre.	Like previous year, the time of application was highly significant, but the sources of nitrogen or the interaction between source and time of application were not significant. Highest yield of fibre was obtained from 3 split applications ($\frac{1}{3}$rd. at Sowing, $\frac{1}{3}$rd at 3 weeks and $\frac{1}{3}$rd at 6 weeks crop-age). It was in the same critical group with all other treatments except one application made either at 3 weeks or at 6 weeks crop-age. At Gograghat, another trial was conducted with ammonium sulphate applied in 1, 2 or 3 splits at various stages of jute. The crop was badly attacked by stem rot and root-rot and was harvested earlier than the scheduled date.	Study concluded.
2. Effect of NPK on the yield of fibre.	One trial each at Kendrapara and Gograghat with *capsularis* jute, two each at Katihar and Sorbhog with both *capsularis* and *olitorius* were taken up. The crops at Sorbhog were attacked by pests and diseases and the trials were rejected.	To be continued.

3. Effect of new-fertilizer mixture on the yield of jute fibre.	Two trials, one with *capsularis* and other with *olitorius*, were taken up. In *capsularis*, highest yield of 41.76 md. of fibre was obtained by the application of 'Complesol', followed by ammonium sulphate (40.78 md.) and 'Nitrophoska-green' (39.50 md.), all being in same critical group. In *olitorius*, application of ammonium sulphate alone gave the maximum fibre yield of 29.21 md., followed by Nitrophoska-blue (28.88 md.) and ammonium sulphate + P + K (28.42 md.). Thus, the result of both the trials showed that the application of fertilizer mixtures had no appreciable advantage over ammonium sulphate alone.	To be continued.
4. Variety-cum-manuring-cum sowing practices on yield of fibre (*C. capsularis*).	It had been observed from the analysis of data that the effect due to variety and manure individually and the interaction between manure and sowing practices were significant. But the sowing practices and other inter-actions were not significant. Amongst the varieties, JRC-212 gave the highest yield and was significantly superior to D154 and local. As regards manurial levels, highest yield was obtained with the application of $N_{80}P_{40}K_{40}$ (34.02 md./acre) followed by $N_{40}P_{20}K_{20}$ (31.35 md./acre) and control (26.65 md./acre) each being significant to each other.	To be continued.
5. Maximum potential studies of manuring on yield of jute fibre.	To study the effect of increasing levels of nitrogen with or without PK, two trials each at Sorbhog and Katihar, one each at Kendrapara	To be continued.

Programme of work as sanctioned	Progress of work in 1960-61	Future pogramme of work in 1961-62
	and Gograghat were taken up. At Kendrapara, yield of jute fibre increased with increasing levels of nitrogen upto 80 lb. N/acre. Presence of PK tended to give slightly higher yield than N/alone. At Sorbhog timely inter-culture could not be given due to continuous rain, moreover, the crops were badly damaged by diseases. The results did not give any definite trend.	
6. Simple manurial trials in cultivators' field.	Out of 109 trials (87 in non-acid zone and 22 in acid zone) so far reported from various jute growing states of West Bengal, Bihar, Assam, Orissa and U.P., the results showed that application of NPK closely followed by NP was the best for all non-acid zones of Bihar. NPK gave on an average an extra yield of 7 mds. and NP gave 6 mds. over control. In acid zone of Bihar, application of 6 mds. lime + 20 lb. N gave on an average 6.33 md. of extra fibre over control. In West Bengal (24 Parganas), Orissa (mainly Cuttack) also, NPK yielded highest. In West Bengal both in *capsularis* and *olitorius*, NPK gave 4.86 and 4.35 md. extra fibre respectively, closely followed by NK giving about 4 and 3 md. extra over control. In acid zone	Study concluded.

	of West Bengal, only 3 trials were successful ; application of 3-6 md. lime plus 20 lb. N on average, gave 6-7 mds. of extra fibre over control. In Assam and U.P. also, the application of NPK gave the highest yields.	
Cultural trials		
1. Effect of spacing on yield of jute fibre.	The season being very late, the trial could not be sown.	
2. Effect of interculture.	2 hand weeding—thinnings and 4 wheel hoeings gave the highest yield (26.11 md./acre). When 6 hoeings were given in place of 4, no extra advantage was observed. 4 hand weedings plus 4-6 wheel hoeings also proved unnecessary and uneconomic.	Study concluded.
3. Effect of scrapping and wheel hoeing on yield of jute fibre.	Preliminary observations were made, to study the effect of scrapping and wheel hoeing in one direction or across, both in line and broadcast sown jute. The result showed that wheel hoeing and scrapping in one direction in broadcast plots, which ultimately left the plant in lines, gave slightly higher yield over normal inter-culture, by about a maund in *capsularis* jute. In *olitorius*, however, highest yield was obtained from treatment receiving wheel hoeing, scrapping and hand thinning in line sown jute. Jute originally sown broadcast and intercultured by a wheel hoe or	To be continued.

Programme of work as sanctioned	Progress of work in 1960-61	Future programme of work in 1961-62
	scrapper in one direction to leave the plant in rows and finally thinned out to requisite spacing also yielded more or less same as in control.	
4. Effect of date of sowing on yield of jute fibre.	Trials were taken up at Sorbhog, Kendrapara and Gograghat to find out the optimum date of sowing for the localities. At Sorbrog, sowing done by 1st March gave the highest yield in both *capsularis* and *olitorius* jute. At Kendrapara, sowing done by the end of March gave better results as compared to sowings done earlier or later. At Gograghat the trial failed due to heavy mortality of plants during the drought period.	To be continued.
5. Effect of harvest at different stages of crop growth on the yield of fibre.	The trial with *capsularis* jute was taken up in the lowlying areas at Gograghat. Like the previous experiment i.e. "Date of sowing", high mortality of jute was recorded during the drought period and the trial was ultimately rejected.	To be continued.
6. Effect of seedrate on seed yield.	Two trials, one with *capsularis* and other with *olitorius* were conducted at Katihar. Increase in seed rate upto 6 lb. in *capsularis* and 3 lb. in *olitorius*, gave correspondingly	To be continued.

	higher yield of jute seed. Further increase in seed rate did not give any extra advantage. *Capsularis*, with 6 lb. seed rate yielded 6.93 md. followed by 6.29 md. with 5 lb. seed rate. In *olitorius*, at 2 lbs. seed-rate, the seed yield was 6.77 mds./acre.	
Triple cropping		
1. Triple cropping with jute, paddy and pulses (with varying dates of sowing of jute).	Jute as a first crop was sown in mid-April, end of April and mid-May and harvested at 120, 105 and 90 days crop-age followed by second crop of paddy. Like last year JRC-212 gave more fibre than JRC-321, though they were sown on same date and harvested at the same age of crop growth. Jute sown by the end of April and harvested at 105 days crop-age gave slightly higher mean yield than earlier sowing and harvested at 120 days crop-age or later sowing by mid-May and harvested at 90 days crop-age. Paddy as a second crop after jute yielded slightly more than single crop paddy transplanted on the same date. Like last year, application of heavy doses of manure was found to depress the yield of grains but increased the straw markedly. Pulse (Lathyrus sativa) as a third crop responded similarly to that of paddy.	To be continued.

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2. Triple cropping with jute, paddy and pulses (with varying dates of transplanting paddy).	First crop jute was sown by end of April and harvested at 90, 105 and 120 days crop-age. Jute sown on same date and harvested at later stages yielded correspondingly higher fibre than earlier harvests. Paddy as a second crop after jute gave slightly higher yield of grain than paddy as single crop, when transplanted on the same date. Earlier transplanting by 1st August yielded less grain but more straw than transplanting i.e. 16th and 31st August. Pulse (lathyrus sativa) as third crop sown broadcast at later stage of standing paddy yielded 4 to 6 mds. of grain/acre	To be continued.
Manurial trial with *H. sabdariffa* (RT-2).	The trial was repeated on the same model as in last year. It was observed that N in form of A/sulphate @ 80 lbs./acre gave 45% increased yield of fibre over the control. It was also observed that N in form of compost @ 80 lbs./acre, increased the yield up to 67% over the control.	To be repeated.
C-Section of Agricultural Chemistry		
Soil Studies		
Soil studies in relation to rotation of crops with jute.	The result with mustard, onion and potato was similar to that of the previous year. No	To be continued.

marked difference had been observed in the soil by growing six varieties of jute—JRC-212, D154, Fanduk (*C. capsularis*) and JRO-632, JRO-620 & C.G. (*C. olitorius*) for six years.

Application of nitrogen from 0 to 320 lb. per acre with and without liming for 4 years and growing jute, produced several changes in the soil. The important changes were :

(i) Total nitrogen and organic carbon had increased which had a relationship with the amount of nitrogen applied, irrespective of liming.

(ii) Exchangeable calcium had fallen.

(iii) pH had fallen in unlimed plots markedly and in limed plots also there was a fall to a lesser extent.

(iv) Exchangeable K_2O increased markedly.

The loss of added available nitrogen from ammonium sulphate was more in the soil cropped with jute where pH was less. The rate of nitrification was also found to be lower in such soils. Application of superphosphate could not counteract the loss of seminormal acetic acid soluble calcium under cultivation of jute.

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	With the increase in organic matter, the availability of manganese was reduced and the copper fixation capacity increased. Acid producing fertilisers tended to increase the availability of manganese.	To be continued.
Microbiological studies.	Work was done on the correlation of soil moisture and soil microflora. Greater number of fungi were observed in the drier conditions of the soil, which was more evident when the soil was incorporated with carbohydrates. The bacterial count showed a positive significant correlation with the moisture content. The effects of nitrification on varying moisture levels were significant at 5 per cent level.	To be continued.
Role of soil conditions regarding susceptibility to diseases.	Amino acids get up of some diseased and non diseased plants were slightly different. The best yield of jute was obtained when Ca : K (applied to the soil) was 2 : 1. B, Cu, Mo, Zn, V, Co, and Mn have a role in the yield of fibre and seed.	To be continued.
Influence of soil conditioners on the soil texture.	Work was continued at the substations with the same treatments in the same plots as in the previous years.	To be continued.

Quality of fibre		
Colouration of fibre.	It had been found that besides ferrous iron, calcium and manganese, the soluble salts, total nitrogen and pH of the water exerted ān important role in the formation of colour. Besides shoti leaves at Sorbhog and Kans grass at Gograghat, Screw pine leaves at Kendrapara gave best results so far colour and lustre were concerned. Increase of oxygen tension also produced better coloured fibre and lowered the retting period.	To be continued.
Retting of Jute	Dhaincha (*sesbania bispurisa*) lowered the retting period at Kendrapara and at J.A.R.I. Shoti leaves, Kans grass and screwpine leaves used as covering material have lowered retting period at Sorbhog, Gograghat and Kendrapara respectively.	To be continued.
Biochemical changes during retting.	It has been found that during retting of *Hibiscus cannabinus*, *Hibiscus sabdariffa* and *Boehmeria nivea*, hemicelluloses were also decomposed.	To be continued.
Isolation and maintenance of cultures responsible for retting.	3 cultures had been obtained from American type collection. A mixed culture obtained from rotting plants from Gograghat had given favourable results under laboratory conditions. A new nitrogen fixing organism had also been found from these.	To be continued.

Programme of work as sanctioned	Progress of work in 1960-61	Feture programme of work in 1961-62
Use of retting water as fertiliser for paddy.	Retting water alone gave about 25% higher yield of grains in glazed pots.	To be continued.
D. Mycology and Plant Pathology		
I. Study of the microflora of jute and jute fields.		
(i) Isolation of new fungus, if any, and study of the isolated ones in detail.	4 fungi including 3 unidentified members of 'mycelia sterilia' and *Aspergillus niger* were isolated. Their presence in certain plots had been noted repeatedly.	Fungi of the rhizosphere of plants in healthy and sick jute field and that of rhizoplane will be investigated (In collaboration with chemistry section).
II. Study of the stem-rot fungus and Associated organism.		
(i) Study of the biochemical changes in leaves of resistant and susceptible types (In collaboration with chemistry section).	Reported under section of chemistry.	To be discontinued.
(ii) Effect of temperature on the incidence of root-rot.	Earlier findings were confirmed ; the fungus *Macrophomina phaseoli* remained active when soil moisture was as low as 5 percent and was	Concluded.

	a virulent parasite on seedlings between 37°C and 41°C of soil temperature at 5 cm. depth.	
(iii) Study of the effect of foliar application of potash on JRC-212 of different age.	Potassium nitrate (300 ppm) as foliar spray did not give any indication that it helped in checking stem-rot. Records from trials conducted by Physiologist showed that urea was a better source of nitrogen both for basal dressing and foliar spray with regard to reduction in the incidence of disease.	Records to be taken in trials to be conducted by Physiologist.
(iv) Preliminary investigations on the antagonism of soil micro-organisms against *Macrophomina phaseoli*.	Isolation from rhizosphere of normal fields (without incidence of disease) yielded bacterium which showed clear antagonism to *M. phaseoli*.	To be done in detail to find in what way the fungus is kept in check in nature.
III. Study of pathogens other than *Macrophomina phaseoli*.		
(i) Inoculation studies with pathogen earlier reported as *Vermicularia* Sp.	The fungus had been identified as a species of Colletotrichum and it had positive parasitism on mature *olitorius* plants. A species of *Phomopsis* was also found associated.	To be repeated.
(ii) Study of the development of anthracnose disease in the field.	The development symptoms on *capsularis* varieties were described and connotated with temperature and humidity.	Concluded.

Programme of work as sanctioned	Progress of work in 1960-61	Future programme of work in 1961-62
(iii) Investigations on the new pathogens of jute.	The two bacteria associated with wilt of jute have been isolated and purified.	Inoculation tests to be repeated if " green house " facilities are available.
IV. Investigations on control of Jute diseases.		
(i) Selection for Resistance to stem-rot.	*Capsularis* no. 1172 is a desirable branching type ready for multiplication both from yield and resistance points of view. Nos. 1640, 1637 and 1652 are also desirable from resistance point of view.	Seeds to be released to sub-stations for multiplication or further yield trials.
(ii) Incidence of stem-rot and anthracnose in different *capsularis* varieties.	Records of disease as collected from large field trials have been handed over to Plant Breeding Unit.	To be repeated in case of advanced trials.
(iii) Influence of fertilizer on the incidence of stem-rot.	In Kendrapara trials showed that plots receiving N at 80 lb. or beyond per acre suffer heavily from stem rot. Addition of P or K did not help.	Records to be taken in trials conducted by Agronomy Section at H.Q. and at Kendrapara.
(iv) Selections from F6, D154 × JRC-412 as tried in Gogra-ghat and Sorbhog.	The crop of Sorbhog was not up-to the mark ; therefore only seeds were carried forward. In Gogaghat, selections were made.	Yield trials to be conducted at Gogaghat and Sorbhog.

	Some selections were multiplied at Nilganj.	
(v) Relative efficacy of fungicides in the field.	Copper oxychloride 0.75% gave effective protection upto 4th week. Tenac did not help as a sticker.	Investigations for a suitable sticker to be started.
(vi) Study of the effect of different rotations.	Green manuring with Dhaincha every fifth year reduced incidence of stem & root-rot. In another rotation, Aman paddy in third year and G.M. in fifth year gave excellent results.	Records to be taken in plots following different rotation.
(vii) Survey report on the basis of Jute Field Assistants, report of the different States.	Study being continued.	Will be completed.
V. Disease of Hibiscus fibres.		
(i) The selections from F6 from *H. cannabinus* × *H. radiatus* to be studied.	Disease brown-rot and anthracnose appeared in mild form. Suitable selections were brought forward.	Further selections to be made, if necessary.
(ii) Studies of effects of manures and fertilizers on the incidence of foot & stem-rot on *H. sabdariffa*.	Statistically, not much differences were observed between different treatments of NPK. But there was indication of slight reduction in incidence by phosphatic fertilizers.	To be repeated if land for trial is available.
(iii) Effect of deep ploughing on the incidence of foot & stem-rot on roselle.	No differences were observed in the two treatments viz. 9″ deep ploughing and ordinary ploughing (4″ deep).	May be done under cultivators condition.
(iv) Relative resistance of mesta and roselle to foot and stem-rot.	Mesta resisted *Phytophthora parasitica* more efficiently than roselle.	Incidence of disease in 'mesta' and 'roselle' to be recorded.

Programme of work as sanctioned	Progress of work in 1960-61	Future programme of work in 1961-62
E-Section of Entomology		
Nupserha bicolor postbrunnea		
(i) Reciprocal exposure of diapause larvae to low and high moisture treatments in soil.	Reciprocal treatments have been given to diapause larvae to low (below 2%) and high (16% approx.) moisture content in soil, at one and two months' interval. Observations are being continued.	To be continued.
(ii) Parasites.	Two actoparasitic species namely *Neocatolaccus nupserhae* and *Norbanus acuminatus* have been described.	Study of the relative efficiency of these parasites.
(iii) Effect of different percentages of damage at different stages of growth on fibre yield.	The trial failed due to adverse conditions.	To be taken up later.
Apion corchori		
(i) Zonal distribution of incidence on stem during different periods of the season.	During the first week of September and second and third week of October, bottom portion had preference for incidence over the middle and the top portion.	To be continued.
(ii) Ovarial score during different periods of the year.	Ovarial activity did not remain altogether suspended during the off-jute season even though the score became low.	To be continued.

(iii) Selection for resistance.	20 *capsularis* selections & 19 *olitorius* selections were sown in two separate trials keeping D154 & C.G. respectively as controls. Promising selections have been brought forward.	To be continued.
(iv) **Parasites**	Few parasites collected, are under observation.	To be continued.
Anomis sabulifera		
(i) Immature stages.	Observations on the distinctive morphological characters of different instar caterpillars and pupal phase had been made.	To be continued.
(ii) **Parasites.**	*Sisyropa formosa* and *Litomastix* sp. had been recorded as endoparasites.	To be continued.
Meloidogyne incognita		
(i) Relative susceptibility of *olitorius*, *capsularis*, *mesta* and *roselic*.	JRO-632, C.G., JRC-212, D154, MT-129, MT-128, RT-1 and RT-2 were tested for their relative susceptibility. Roselle types had been found to be less susceptible than jute or mesta.	Completed.
(ii) Jute weeds as alternate host.	*Blumea lacera* (compositae) *Ageratum conyzoides* (compositae) *Rungia parviflora* (Acanthaceae) and *Oldenlandia corymbosa* (Rubiaceae), which were found as jute field weeds during later part of the season, had been recorded as alternate hosts.	To be continued.

Programme of work as sanctioned	Progress of work in 1960-61	Future programme of work in 1961-62
Agrilus acutus		
(i) Host preference studies with reference to jute and Allied Fibre crops.	JRC-212, JRC-321, JRO-632, JRO-620, MT-129 and RT-1 were selected for the study. Highest incidence was recorded in mesta. No incidence was however recorded in jute, though casual incidence was noted in *olitorius* jute in the previous year.	To be continued.
(ii) Varietal susceptibility of mesta.	Five varieties of mesta (269, 583, 584, 867 & MT-15) were tested for their relative susceptibility in a trial conducted by the Allied Fibre Unit. Conditions were not favourable for high level incidence of the pest. MT-15 and variety 584 did not show any incidence during second month stage of growth, though these were affected during 3rd month stage.	To be continued.
Residual effect of DDT when in soil on plant growth and fibre yield.	*Capsularis* (D154) and *olitorius* (C.G.) Jute were raised in two separate layouts which were treated in previous years with different doses of DDT. No adverse residual effect has been noted either on *capsularis* and *olitorius* jute.	Completed.
Insect pollinators of jute	Collection of insect fauna had not been sufficient for making any conclusion.	To be taken up later on.
Apportioning the role of insects as pollinators vis-a-vis other agencies.	JRC-212, JRC-321, JRO-632 and JRO-620 were raised for the purpose. Necessary selections before flowering, with and without screening were made on JRC-212 and JRO-632 and relevant records maintained.	To be continued.

General Programme of work	Proposed work in 1962-63	Remarks
Section of Plant Breeding and Genetics **Breeding and Genetics Unit** **Jute** A. **Breeding** 1. Introduction of indigenous and exotic types of cultivated and wild species of *Corchorus*. 2. Improvement of *capsularis* and *olitorius* jute in respect of yield and quality of fibre.	Collection and maintenance of indigenous and exotic types of jute. (a) *Selection*—Desirable types in the indigenous and exotic materials will be isolated. (b) *Hybridization*—Selections from the F_5 population of two intervarietal hybrids between JRO-632 and two Russian types, will be grown in Nursery Tests along with other selections. Two other *olitorius* hybrids between JRO-632 and JRO-620 and an exotic type from Sudan will be grown at the F_5 stage under the Modified Mass Method. Selection of desirable plants will be made from the said crosses. (c) *Microplot Tests*—Materials carried forward from Nursery Tests and Microplot 'A'	To be continued.

General Programme of work	Proposed work in 1962-63	Remarks
	trials will be tested in Microplot 'A' and B' trials.	
	(d) (i) *Varietal trials—Capsularis* and *olitorius* varietal trials already in progress at Jute Agricultural Research Institute will be repeated.	These will be also repeated at the Substation, if facilities exist.
	(ii) New promising varieties, if any, carried forward on the results of microplot trials will be tested in small bulk trial.	
	(iii) The combined trial of improved *capsularis* and *olitorius* varieties will be repeated at the Main Station.	This will also be repeated in the Substation, if facilities exist.
	(e) *Simple varietal trials* (*Subvention trials*) *in cultivators' plots*—Simple varietal trials, with the new *capsularis* varieties, in cultivators' plots in jute growing States, will be continued.	The number of such trials will be increased from 28 only in 1961-62 to about 100 in order that, after allowing for unavoidable failures, some dependable data may be obtained for recommendation of suitable varieties on a zonal basis.
3. Breeding for resistance to stem-rot and other diseases of jute.	Selections made in some hybrid materials will be grown in a Nursery Test.	In collaboration with Mycology & Plant Pathology Section.

4. Breeding for resistance to drought.	The work will be carried out at Jute Research Substation, Gograghat, U.P., where extreme drought conditions prevail during the premonsoon period from March to June, if facilities exist.	In collaboration with the Physiology and Anatomy Units.
5. Breeding *olitorius* types resistant to lodging.	Will be continued.	
6. Breeding *olitorius* jute for early sowing.	To be continued.	
7. Interspecific hybridization in jute (*C. olitorius* × *C. capsularis*).	The materials under study will be followed up	In collaboration with Cytogenetics & Plant Anatomy Units.
8. Comparative study of the yield components in two improved *olitorius* varieties, JRO-632 & C.G.	Studies will be continued.	
B. Genetics		
1. Genetic strains.	The existing stock of strains in our collection will be maintained and further additions, if any, will be made.	
2. Inheritance of non-shattering capsule character in *olitorius* jute.	Isolation of non-shattering types will be continued.	In collaboration with Cytogenetics Unit.

General Programme of work	Proposed work in 1962-63	Remarks
3. Inheritance of quantitative characters like plant height, basal diameter, maturity etc. in *olitorius* jute.	Selection of suitable parents and hybridization will be taken up.	
Allied Fibres		
A. **Breeding**		
1. Introduction of new types.	Observation on the performances of the types, both indigenous and exotic collected, under J.A.R.I. farm conditions.	
2. Improvement of crops in respect of yield and quality of fibres.	(i) Plants with promising growth and vigour will be selected for further studies.	
	(ii) Progeny row-test : In Roselle, (*H. sabdariffa*) promising materials carried forward from 2nd year trial will be tested in 3rd year.	
	(iii) Microplot test : In Roselle, (*H. sabdariffa*) promising types will be tested in 'C' trials.	
	(iv) *Varietal trials* :	
	(a) Varietal trials in *H. sabdariffa* will be continued.	To be taken up also at J.R.S., Katihar, if facilities exist.

	(b) Varietal trial in *H. cannabinus* will be carried out with new promising materials.	To be taken up also at J.R.S. Katihar, if facilities exist.
	(v) Varietal trials in cultivators' plots : Trials will be continued in U.P.	If facilities exist.
3. Intervarietal hybridization.	(i) Observation and isolation of promising types from the F_2 and F_3 progenies of the crosses between R.T. 2 and R.T. 1 N. Br. strains of roselle (*H. sabdariffa*).	
	(ii) Observation and isolation of promising types, if any, from the F_2 progenies of the crosses between R.T. 2 and intermedius strains of roselle (*H. sabdariffa*).	
	(iii) Reciprocal crosses between early and late flowering strains of *H. sabdariffa* will be carried out.	
4. Interspecific hybridization.	Reciprocal crosses between *H. cannabinus* and *H. sabdariffa* will be attempted.	
B. Genetics		
1. Genetic strains.	Maintenance of the existing stock of strains of different Allied Fibres, will be continued.	

General Programme of work	Proposed work in 1962-63	Remarks
Cytogenetics Unit		
1. Studies on the induced mutations.		
A. X-ray-irradiated materials	(i) Isolation of variants for desirable economic characters in jute.	1. A & B.
	(ii) Purification and crossing of variants selected on the basis of earliness, vigour, non-branching habit, non-shattering pod, disease resistance and drought resistance.	In collaboration with Mycology and Plant Pathology Section.
	(iii) Cytogenetical study of the variants	
B. Gamma ray-irradiated materials.	(i) Isolation and purification of variants in jute with desirable economic characters and crossing wherever necessary.	
	(ii) Cytogenetical study of the variants.	
	(iii) Irradiation of allied fibre plants (mesta, roselle, sunn-hemp, ramie) with gamma ray for induction of mutations.	Materials to be obtained from Allied Fibres Unit.

C. Yield trial of X-ray induced variants.	(i) Replicated randomized microplot trials of X-ray induced variants at X_5, to find out the selections with better performance with reference to yield of fibre.	
	(ii) Second year yield trial of non-branching, early flowering variants of JRC-919 (*C. capsularis*).	
2. Study of Colchicine treated series.	Maintenance and selection of Colchiploids in jute.	
3. Cytogenetical studies of the crosses of jute and allied fibre plants.	(a) Interspecific hybridization in jute and allied fibre (mesta, roselle, etc.) plants.	
	(b) Study of the progenies of crosses from interspecific grafts (e.g. : *C. aestuans* × JRC-212, etc.) and selection.	
	(c) Study of progenies of intervarietal crosses of jute at different ploidy-level.	
Anatomy Unit		
1. Anatomical studies of variants arising out of X-ray and gamma ray-irradiation.	(a) Developmental and histological studies of the stem, leaf and pod variants of jute.	Materials from Cytogenetics Unit.
	(b) Fibre analysis from transverse section of the stem variants.	
	(c) Comparative histochemical studies of the variant and normal irradiated types.	

General Programme of work	Proposed work in 1962-63	Remarks
	(d) Anatomy of the seed wall of the seed variants.	
	(e) Anatomy of the roots of some variants arising out of X-ray-irradiation.	
2. Leaf area and its relation to yield.	Study (to be continued for the second year) of the leaf size variation in jute at different phases of growth. Determination of leaf area index and its correlation with yield.	In collaboration with Plant Physiology Unit.
3. Anatomical studies of the disease and pest-infected plants of jute and allied fibres.	Study of developmental and anatomical irregularities due to attack of pathogenic fungus and insects.	In collaboration with Mycology & Plant Pathology and Entomology Sections.
Section of Plant Physiology and Agronomy		
Plant Physiology Unit		
1. **Nutritional investigations**		
(a) Foliar application of Nutrients.	Continuation of the foliar spray application with two levels of 20 lbs. N and 40 lbs. N/acre and also in split doses and comparison to be made with the same when applied as basal dressing.	Assessment of incidence of diseases and pests in collaboration with Mycology & Plant Pathology and Entomology Sections.

(b) Effect of Micro-nutrients on Growth and Development.	Continuation of the study of the deficiency symptoms in JRO-632 and JRC-212 with or without and in combination of the different trace elements (Boron, Copper, Manganese, Zinc, Molybdenum) with special reference to Nitrogen metabolism.	JRO-632 and JRC-212 in sand culture experiments.
2. **Investigations on the flowering behaviour.**		
(a) Early flowering strain of JRO 475-55.	Continuation of the studies with the newly evolved strain with reference to flowering behaviour and yield.	In collaboration with Plant Breeding and Genetics Unit.
(b) Flowering behaviour of early and late formed selfed capsules.	The material collected in JRO-632, JRO-620, JRO-753 and R-26 and JRC-212, JRC-919, D154, Jap red and JRC-321, would be further studied.	
3. **Investigations on the effect of synthetic hormones on growth and development.**	The increase in yield obtained as a result of hormone spraying on the shoot portion would be followed up in small scale field trials. The hormones IAA, IPA, IBA and NAA will be used on JRO-632 and JRC-212.	
4. **Effect of Gibberelic acid.**	Preliminary results obtained would be followed up, in JRO-632 and JRC-212.	In collaboration with the Plant Anatomy Unit.

General Programme of work	Proposed work in 1962-63	Remarks
Agronomy Unit		
Jute		
1. NPK trial with *capsularis* (JRC-212) & *olitorius* (JRO-632) jute.	To study the effect of NPK at various levels singly and in their combinations on the yield of jute fibre.	Studies on soil exhaustion will be taken up by the Agricultural Chemistry & Microbiology Section.
2. Maximum potential studies on manuring—*capsularis* (JRC-212) & *olitorius* (JRO-632) jute.	To study the response of jute to increasing levels of N (0 to 160 lb. per acre) alone or along with PK (0 to 80 lbs. each of P_2O_5 and K_2O per acre) on the yield of jute fibre and also to find out the response curve and optimum dose of manuring.	Studies on soil will be made by Agricultural Chemistry & Microbiology Section while assessment of diseases by Mycology & Plant Pathology Section.
3. Effect of organic manure and Ammonium sulphate alone and in combinations at various proportions (*C. capsularis*—JRC-212).	To study the effect of Nitrogen, from organic manure and fertilizers alone and in combinations at various proportions on the yield of jute and soil productivity.	Plant analysis to be done.
4. Effect of interculture in line & broadcast sown crop with *capsularis* (JRC-212) & *olitorius* (JRO-632) jute.	To study the effect of interculture in one direction or across in line and broadcast sown crop on yield of jute fibre.	To be continued.

5. Spacing with *capsularis* (JRC-212) & *olitorius* (JRO-632) jute.	To study the effect of various spacing in rectangular or square system of sowing on yield of jute fibre.	To be continued.
6. Seed rate-cum-Spacing with *capsularis* (JRC-212) & *olitorius* (JRO-632) jute.	To study the effect of seed-rate and spacing and subsequent interculturing on the yield of jute fibre in broadcast sown crop and to compare its performance with line sown jute.	To be continued.
7. Effect of weedicide (Dowpon) with *olitorius* (JRO-632) jute.	To study the effect of different doses of weedicide (Dowpon) for controlling the weed in jute field and to find out the optimum level.	To be continued.
8. Rotational trials (2 yrs. rotation).	In the first year, raising of crop of jute for uniformity trial before actual commencing of the rotational trial.	
Allied Fibres		
1. Soil exhaustion studies with regard to Roselle.	Experiments to be conducted with different manures.	In collaboration with the Sections of Mycology & Plant Pathology and Agricultural Chemistry & Micro-biology.
2. Manurial trial on Roselle.	To study the effect of NPK at various levels singly and in different combinations.	To be continued.

General Programme of work	Proposed work in 1962-63	Remarks
Agricultural Chemistry & Microbiology Section		
A. Soil studies		
1. Soil studies in relation to cropping with jute.	Investigations on the nature of soil acidity prodced by growing jute year after year and how far this acidity is related with the availability of different trace elements in the fields where jute is grown alone in the same field year after year with and without different fertilizers and different cropping pattern and also with different varieties of jute. The nitrifying capacity of different nitrogenous fertilisers to plots receiving very high doses of fertilisers will be determined.	In collaboration with Agronomy Unit.
2. Role of soil conditions regarding susceptibility of plant grown thereon to disease.	It is proposed to study the effect of (a) fertilisers (particularly different ratios of Ca : K)— (i) causing variations in the amount of Ca and K in the plant. (ii) changes in the soil microflora.	In collaboration with the Mycology & Plant Pathology Section.

	and (b) of trace elements— (i) on the susceptibility to diseases. (ii) on the changes in the soil microflora.	
3. Use of retting water as fertiliser.	To study the effect on yield of paddy in plots irrigated with retting water and compared against fertilizer applications. Work will be carried out in plots also.	
4. Residual effect of ammonium sulphate.	Field work will be carried out by growing sulphurloving crops like mustard and onion and other similar crops after jute to find whether SO_4 accumulates and can be removed. Soil to be analysed for SO_4, C/N ratio, pH and exchangeable Al.	In collaboration with Mycology & Plant Pathology Section.
B. Quality of Fibres		
5. Studies on the '**shyamla colour**' of jute fibres.	Mechanism of formation and methods of its prevention by using oxidising substances and other aquatic weeds will be studied.	
6. Studies on the quality of fibre as affected by edaphic factors.	To test how far intrinsic qualities of fibre are affected by edaphic conditions—like fertility status, soil texture, etc. (Last year).	
7. Shortening of retting period.	Attempts will be made to shorten retting period by inocculation with different ret-causing organisms and nitrogen-fixing organisms. To	

General Programme of work	Proposed work in 1962-63	Remarks
	find out the possibility of fungal retting and bacterial retting under controlled pilot scale conditions. Attempts will also be made to find cheaper and easily available materials for the above purpose and to find out materials suitable for combining with *Dhaincha*, Sunn hemp stems, etc. and the effect of other leguminous plants will also be studied.	
8. Retting of seed-jute plants.	Laboratory scale studies with wetting agents and ret-causing organisms to be further extended.	
9. Isolation and identification and search for ret-causing organisms.		
10. Study on the retting process.	This study will be made with special references to changes in the temperature.	
11. Study on the retting of allied fibres.		

Mycology & Plant Pathology Section		
1. Study of microflora of jute fields.	(i) Isolation of microbes from sick and normal jute fields for a comparative study. (ii) Study of antagonism of microbes against *Rhizoctonia bataticola* (Taub) Butler.	In collaboration with microbiological unit of the Agricultural Chemistry Section.
2. Studies on the perfect form of **Rhizoctonia bataticola** (Taub) Butler.	(i) Pathogenicity test of 3 different types of cultures obtained from *ascospores* of the perfect form. (ii) Behaviour of the monosporous cultures obtained from pycnospores of *Macrophomina phaseoli* (Maubl.) Ashby.	
3. Pathogenicity of *Phomopsis* sp. isolated from *olitorius*.	Inoculation studies to be done with JRO-632 as host.	Repetition of 1961 tests.
4. Pathogenicity of *Colletotrichum* sp. isolated from *olitorius*.	Inoculation studies to be done with JRO-632 as host.	
5. Investigation on the chemical control of secondary infection of stem-rot.	(i) Exploring possibilities of finding a suitable sticker for copper oxychloride on jute leaves. (ii) Efficacy of new chemicals against stem-rot.	
6. Breeding for resistance to stem-rot and anthracnose in Mesta (*H. cannabinus*).	The final selections from the inter-specific cross (*H. cannabinus* × *H. radiatus*) Nos. 124 and 115 are to be compared against standard MT-129.	In collaboration with Breeding & Genetics Unit.

General Programme of work	Proposed work in 1962-63	Remarks
7. Control of foot and stem-rot in *Hibiscus sabdariffa*.	Effectiveness of Pentachloronitrobenzene as soil fungicide against *Phytophthora parasitica* to be tested in large scale field trial.	Results of trial in 1961 has given encouraging results.
8. Comparative study of yield and resistance to stem-rot in the new strains evolved in jute.	(i) Yield trial at Sorbhog, Assam. (ii) Yield trial at Katihar, Bihar. (iii) Yield trial at Gogragat, U.P	Depending on quantity of seed obtained in 1961 harvest. (If facilities exist after the transfer of the Sub-stations to the respective State Governments).
Entomology Section		
1. Reciprocal exposures of diapause *Nupserha* larvae to low and high soil moisture contents.	Reciprocal exposure will be given to the diapause larvae to low (2% appr.) and high (14-15% appr.) soil moisture contents in a controlled experiment and effects studied.	Some of the treated materials died during the last phase of the experiments and hence, the experiment will have to be repeated.
2. Studies on *Nupserha* parasites.	Further studies on the relative efficiency of the larval and pupal parasites will be made with reference to the different period of the season.	Annual variations in parasitisation will be observed.
3. Studies on *Apion* ovarial score.	Ovarial score will be determined with reference to different periods of jute season and off-jute season after dissection and observations made on the genital system.	Two years' data will be pooled together.

4. Studies on *Apion* parasites.	Collection of different types of parasites and assessment of relative importance.	Collection will be continued.
5. Zonal distribution of *Apion* incidence on jute stem.	Zonal distribution of the incidence of pest will be studied at different stages of growth of two jute types viz. JRC-212 and JRO-632.	Three years' data will be pooled together, for drawing the necessary conclusion.
6. Resistance trial.	Promising *capsularis* and *olitorius* materials will be brought forward for study of the intensity and extent of Apion incidence during different stages of growth.	To study the performance of the promising selections (made from progenies of bulked up seed) in collaboration with Genetics & Plant Breeding Unit.
7. Studies on the immature stages of *Anomis sabulifera.*	Observations on the morphological features of the immature stages will be made during different stages of growth.	Observations will be continued.
8. Insecticidal studies.	Trithion, Sevin, Telodrin, Malathion will be tested against *Anomis sabulifera* under laboratory conditions.	
9. Studies on *Agrilus acutus.*	Two *olitorius* types (JRO-632, JRO-620), two *capsularis* types (JRC-212, JRC-321) and one variety of each of *mesta* and *roselle* will be put in the trial for test.	Studies on the possibilities of *Agrilus acutus* being established on jute from allied fibre crops.
10. Insecticidal studies.	Dieldrin will be used with and without sticker in a field trial against *Agrilus acutus.*	Incidence level is, low during current season for making any conclusion ; and the trial is to be repeated.

General Programme of work	Proposed work in 1962-63	Remards
11. Insect pollinators of jute.	Collection of insect fauna, associated with cross-pollination of jute both in *capsularis* and *olitorius* jute will be made.	First year's collection was not satisfactory due to rain during the flowering period.
12. Studies on *Maloidogyne incognita.*	Assessment of loss of yield due to the pest and control measures (preliminary experiments).	
13. Varietal susceptibility of different types of *H. cannabinus* & *H. sabdariffa* to *Agrilus acutus.*	Assessment of susceptibility of the different types of *H. cannabinus* and *H. sabdariffa* will be made from trial to be conducted by the Allied Fibre Unit.	In collaboration with Plant Breeding & Genetics Unit—Allied Fibre, Data will be pooled together.
14. Studies on prophylactic and curative sprays against *Anomis sabulifera*—No. 1.	Endrex E. C. and Folidol will be used separately as prophylactic and curative sprays and their effects studied.	
15. Studies on comparative efficiency of different insecticides under the field condition.	Efficacy of Telodrin, Malathion, Trithion, Sevin will be tested under the field condition.	

A. **Important lines of investigations, which hold promise and their practical utility.**

Lines of investigations	*Practical utility*
1. Interspecific hybridization between JRO-632 (*olitorius*) and JRC-206 (*capsularis*).	1. Hybrids with as many desirable characters, such as, resistance to water-logging, earliness in maturity etc. of *capsularis* and greater plant height, higher yield per acre, resistance to stemrot disease etc. of *olitorius* may be obtained. These hybrids may help to overcome the drawbacks of individual species.
2. Breeding and selection of *olitorius* strains, which can be grown before middle of April each year. Hybrids of the crosses between Sudan and JRO-632 and Sudan and JRO-620, have been made in this connection.	2. Usually olitorius strains, if sown earlier than middle of April, flower within a very short period, reducing thereby the fibre yield. This difficulty may be overcome by evolving strains, which can be grown before middle of April.
3. Cytogenetical studies on the X-ray and gamma-ray induced mutants and isolation and purification of variants for desirable economic characters.	3. Jute variants, such as, non-branching stem, superior plant height, early maturity, disease resistance, non-shattering pods male or female sterility, haploids etc., have been obtained. These variants may be used in hybridization with the improved strains, with a view to recombine the desirable characters and increase thereby the yield and quality of fibre.

Lines of investigations	*Practical utility*
4. Experiments with foliar application of nutrients— ammonium sulphate and urea.	4. Foliar application of fertilizer has, so far, given the same result as that of fertilizer when applied in the soil. The method of foliar application may be of practical value particularly in those areas, where the crop is grown under water-logged conditions.
5. Nature and range of flowering and seed formation in different strains of jute.	5. Arising out of these studies a selection, JRO-475-1955, showed consistently early flowering by about a month from the standard strain, JRO-632. Further studies are required to see the yield performence. Double cropping can be practised by cultivators if early strains are available.
6. Manurial experiments with different improved varieties, such as, JRC-212, JRC-321 etc.	6. So far, the strain, JRC-212, has proved to be responsive to higher doses of Nitrogen. Application of 60 lb. Nitrogen, has been found to give higher yield in JRC-212 than in the other varieties. Response of other new strains to different doses of manures also requires to be studied.
7. Conduction of experiments to obtain better quality fibre and shortening of retting period.	7. Leaves of "shoti", "Kans", "screwpines", etc., are found to be effective as covering materials during retting. Certain mixed retting organisms, have also been found to

Lines of investigations	*Practical utility*
	reduce the retting period. Further studies are required with these and other materials.
8. Investigations to evolve *capsularis* types resistant to stem-rot disease, caused by the fungus, *Macrophomina phaseoli* and also to evolve effective measures to control infection and spread of disease.	8. Disease resistant high yielding strains, such as, *capsularis* type 1172, will be helpful to increase yield particularly in the disease prevalent localities. Control measures, application of chemicals or agronomical practices, will also help to increase the yield per acre.
9. Investigations to select parasites and predators, such as, *Neocatolaccus nupserah* and *Norbanus acuminatus* on the pest, *Nupserah bicolor postbrunnea*, to control important pests of jute and other allied fibre crops.	9. Parasites and predators of insects have practical utility in controlling pests particularly where the external application of insecticides is of little or no value.
10. Investigations on the role of insects as pollinators.	10. The study will indicate the actual agent involved in crosspollination, which may be of importance from the point of view of increasing yield by heterosis.

B. Experiments which have been concluded.

Name of Experiments.	*Remarks*
1. Nature of range of flowering and seed formation in different varieties of jute.	By selection wide variations in the flowering frequency had been narrowed down.—Study completed.

Name of Experiments.	*Remarks*
2. Effect of temperature and photoperiods on flowering behaviour of jute.	The critical period of photoinduction and the temperature effect had been worked out. —Study completed.
3. Time of application of nitrogen on the yield of jute fibre.	Study concluded. Application of fertilizers in 3 split doses gave the highest yield.
4. Effect of interculture in jute cultivation.	Study concluded. 2 hand weeding and 4 wheel hoeing gave the highest yield.
5. Effect of temperature on the incidence of root-rot.	Study concluded. The fungus, *Macrophomina phaseoli,* was a virulent parasite on seedling when soil temperature was between 37°C to 41°C at a depth of 5 c.m.
6. Relative susceptibility of *olitorius, capsularis, mesta* and *roselle* to the pest, *Meloidogyne incognita.*	Study completed. Roselle types have been found to be less susceptible than jute or mesta.
7. Residual effect of D.D.T., when in soil, on plant growth and fibre yield.	Study completed. No adverse residual effect has been noted.

C. **Results which have been recommended for cultivators.**

1. Jute should be sown in rows with a seed-drill. The distance between two rows should be one foot and that between the plants within a row should be 3-4 inches.

2. During cultivation, two hand weedings followed by 4 wheel-hoeings are recommended. During hand weeding, the excess plants should be thinned out.

3. Judicial application of ammonium sulphate, @ 100 lb. and 200 lb. for *olitorius* and *capsularis* jute respectively, should be done.

4. To avoid diseases and pests, plant protection measures should be taken.

   (i) Different doses of chemicals as recommended should be used to control different pests and diseases.

   (ii) Cultivators of Gangetic alluvial region may follow the practice of growing green manure, "Dhaincha", every fifth year followed by cow-pea, to reduce the incidence of diseases like stem-rot and root-rot.

   (iii) Roselle, which is comparatively resistant to jute nematode, may be grown as a rotational fibre crop in nematode infested jute fields.

5. During retting of jute covering materials like 'Soti' leaves, 'Kans' grass, 'screwpine' leaves should be used to get fibres of good quality. Mud, Banana plant, wood of 'Bael' should not be used during retting.

6. Improved seeds like JRO-632 of *olitorius* and JRC-212, JRC-321 of *capsularis* jute should be used to get more yield per acre.

Star Printing Works, Calcutta-6.